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Preliminary Classification of Forest Vegetation of the Kenai Peninsula, Alaska

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Abstract

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A total of 5,597 photo points was systematically located on 1:60,000-scale high-altitude photographs of the Kenai Peninsula, Alaska; photo interpretation was used to classify the vegetation at each grid position. Of the total grid points, 12.3 percent were classified as timberland; 129 photo points within the timberland class were randomly selected for field survey. The number of sample points visited in each of three forest cover types (conifer, broadleaf, and mixed conifer-broadleaf) was proportional to the frequency of the cover type in the photo sample. Two-way indicator species analysis (TWINSPAN) was used to develop a hierarchical classification of the forest communities observed on the peninsula. Brief descriptions are presented for the 11 recognized communities with a discussion of their relation to basic physiographic and edaphic characteristics.

Keywords: Vegetation classification, Kenai Peninsula, Alaska.

Summary

The PNW Forest Inventory and Analysis Research Work Unit (Anchorage) systematically located 5,597 photo points on 1:60,000-scale high-altitude photographs of the Kenai Peninsula, Alaska. Photo interpretation was used to classify the vegetation at each grid position. Of the total grid points, 12.3 percent were classified as timberland; 129 photo points within the timberland class were randomly selected for field survey. The number of sample points visited in each of three forest cover types (conifer, broadleaf, and mixed conifer-broadleaf) was proportional to the frequency of the cover type in the photo sample.

Cover data for the stand overstory were collected using a five-point pattern of variable-radius subplots at each sampling location. Sapling cover was estimated from five subplots, 1.5 meters in radius, centered on the variable-radius subplots; cover data for other understory layers were obtained from two subplots, 5.64 meters in radius. Elevation, slope, aspect, topographic position, and basic edaphic characteristics were determined for each plot. Two-way indicator species analysis (TWINSPAN) was used to develop a hierarchical classification of the observed forest communities.

The following six communities were all relatively homogeneous in physiographic and edaphic characteristics:

(1) Closed *Picea mariana/Cornus canadensis-Vaccinium vitis-idaea/Peltigera* spp.-*Rhytidiadelphus* spp.;
(2) Open *Picea glauca-Picea mariana/Empetrum nigrum-Vaccinium vitis-idaea/Peltigera* spp.-*Pleurozium* spp.;
(3) Closed *Picea glauca-Betula papyrifera/Cornus canadensis-Vaccinium vitis-idaea/Epilobium* spp./*Pleurozium* spp.;
(4) Closed *Picea* × *lutzii-Betula papyrifera/Menziesia ferruginea-Rubus pedatus/Gymnocarpium dryopteris/Peltigera* spp.-*Pleurozium* spp.;
(5) Closed *Picea glauca-Betula papyrifera/Menziesia ferruginea-Rubus pedatus/Gymnocarpium dryopteris/Lycopodium* spp.-*Pleurozium* spp., and;
(6) Closed *Picea glauca-Picea* × *lutzii/Linnea borealis-Rubus pedatus/Sanguisorba* spp.-*Calamagrostis* spp./*Lycopodium* spp.-*Ptilium* spp.

Within the above group of communities, the fifth was relatively distinctive, with about 70 percent of plots occurring on sandy loam or coarser textured soils. All other communities occurred on finer textured soils with much higher frequency. Most of these communities occurred at low to medium elevations, in low- to mid-slope topographic positions, and with no single aspect predominating, although westerly aspects were slightly more common. Thickness of surface layers of moss and organic matter and of the rooting zone were fairly uniform within these communities. The decomposed organic layer was least developed in the sixth group. Poor drainage, as indicated either by presence of a shallow impermeable layer or by saturated soil was uncommon. The community characterized as Closed *Picea* × *lutzii/Rubus pedatus-Salix* spp./*Sanguisorba* spp.-*Calamagrostis* spp./*Mnium* spp. was similar to the above six communities in most respects but generally occurred at much higher elevations.

The closely related communities, Closed *Picea* × *lutzii-Tsuga mertensiana/Cornus canadensis-Menziesia ferruginea/Sphagnum* spp., and Closed *Picea* × *lutzii-Tsuga mertensiana/Menziesia ferruginea-Oplopanax horridum/Dryopteris dilatata/Rhytidiadelphus* spp.-*Sphagnum* spp., occur at medium to high elevations, on steep slopes, and in mid-slope positions. These two communities occur predominantly on north and south slopes, respectively. Thickness of the surface organic layers and rooting zone is greater in these communities than in the first six, but this latter set of communities had the highest occurrence of saturated soils within 50 centimeters of the soil surface. Soil textures were predominantly silt loams and loams.

The community, Closed *Picea sitchensis/Oplopanax horridum-Rubus pedatus/Dryopteris dilatata-Gymnocarpium dryopteris/Mnium* spp.-*Rhytidiadelphus* spp., occurs in or near the coastal climatic zone. It typically occurs on westerly aspects at low to medium elevations and on moderately steep slopes.

The riparian community, Open *Picea* × *lutzii-Populus trichocarpa/ Alnus* spp.-*Oplopanax horridum/Dryopteris dilatata*, occurs across a broad elevational range. The rooting zone is relatively thick, and surface organic layers are strongly developed. The highest incidence of stands with an impervious layer occurred in this community.

Contents

Introduction

Geography and Geology

The Kenai Peninsula is in south-central Alaska and is bordered on the west by Cook Inlet and on the east by Prince William Sound (fig. 1). The total land area is about 21,104 square kilometers[1] and is composed of two geographically distinct regions, the Kenai Mountains and the Kenai Lowlands (Martin and others 1915).

The Kenai Mountains cover about two-thirds of the total area and include the southern and eastern portions of the peninsula, which are divided from the western lowland area by an imaginary line from the head of Kachemak Bay in the southwest to the head of Chickaloon Bay in the north (fig. 1). Parent materials in the Kenai Mountains are composed primarily of slightly to moderately metamorphosed sedimentary series laid down from the Middle Jurassic to the Late Cretaceous. Some interbedding with mafic igneous intrusions also occurs. The mountains are over 2000 meters in elevation and formed as a result of major uplifting in the Late Cretaceous.[2] The rugged relief of the Kenai Mountains, which is characterized by steep, narrow valleys, is due to glaciation and, to a lesser extent, stream cutting that followed uplifting (Martin and others 1915, Pewe 1975).

The Kenai Lowlands range from 15 to 60 meters in elevation and are composed of two discernible subregions. Immediately west of the mountain region, present lowland topography is the result of the formation of glacial moraines. Further west toward the coast, parent materials consist of silt-rich deposits laid down after the formation of glacially dammed lakes.

Climate

Climatic regimes on the Kenai Peninsula range from cool maritime along much of the coast to continental in interior portions (Selkregg 1974). These climatic zones are separated by a relatively narrow climatic transition zone. Approximate average daily minimum and maximum January temperatures for the peninsula are –13 °C and –2 °C, respectively; average daily minimum and maximum July temperatures are 5 °C and 16 °C, respectively. The peninsula is generally free of permafrost but scattered pockets occur, primarily in muskeg sites dominated by black spruce (*Picea mariana* (Mill.) B.S.P.) in the Kenai Lowlands. Temperature differences can conveniently be summarized for the Kenai Peninsula as a whole, but considerable variation in snowfall and precipitation occur between the mountain and lowland regions. The mountain region receives about 5 to 10 meters of total precipitation annually, of which 1.5 to 4 meters are snowfall. The lowland receives about 1.7 to 2.5 meters of total precipitation annually (including 0.5 meters of snowfall).

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[1] Personal communication, November 11, 1988, Fred R. Larson, research forester, Pacific Northwest Research Station, Forestry Sciences Laboratory, 201 East Ninth Avenue, Suite 303, Anchorage, Alaska 99501.

[2] Hoekzema, Bob. 1979. Minerals task force draft working report on the Chugach National Forest. On file with: Forest Supervisor, Chugach National Forest, 201 East Ninth Avenue, Suite 206, Anchorage, Alaska 99501.

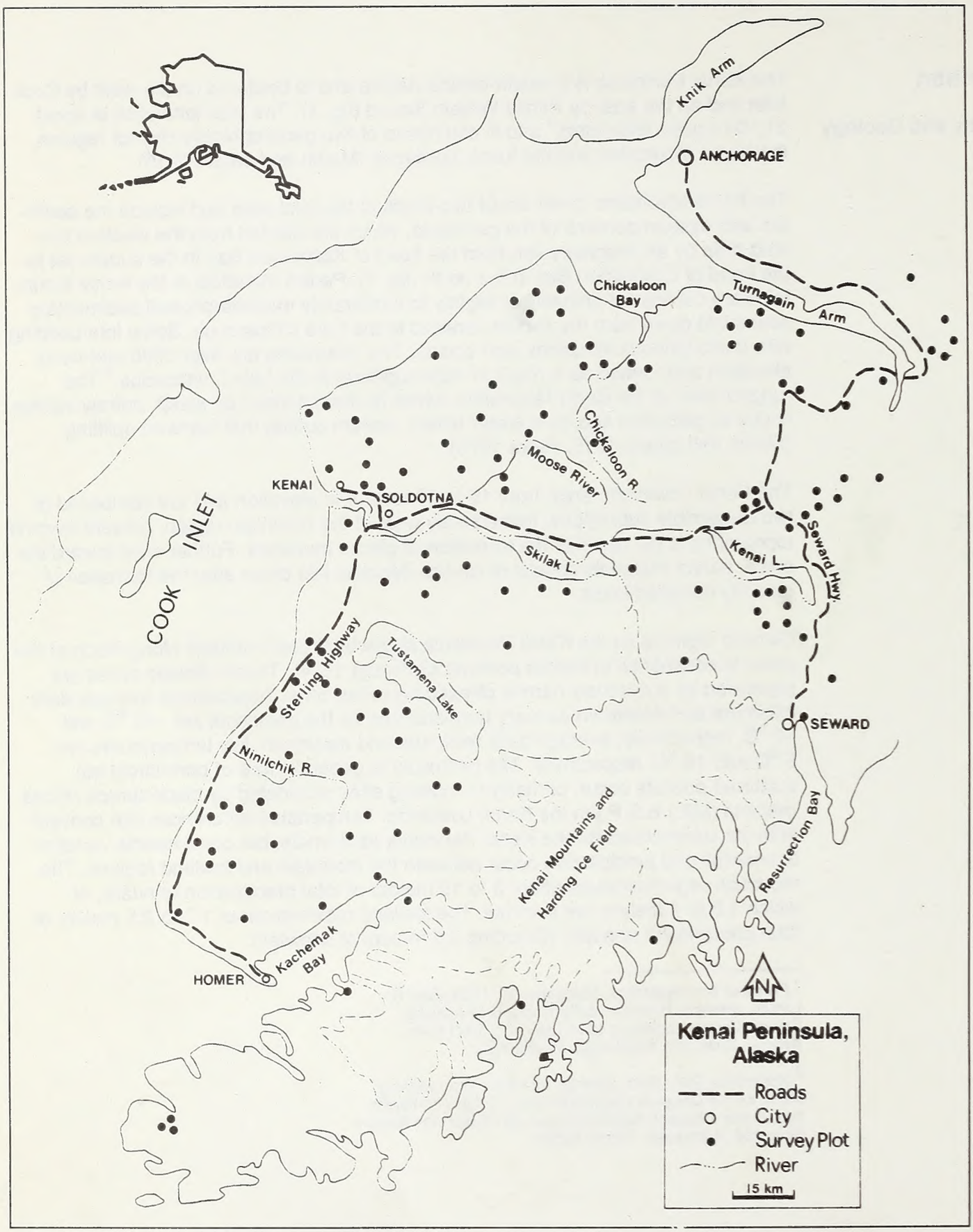

Figure 1—Location of field plots included in inventory survey.

Flora

The vegetation of the Kenai Peninsula is characteristic of the Coniferous Forest Biome. Situated along the south-central coast of Alaska, the Kenai subregion is on the boundary of the southern boreal forest and coastal biogeoclimatic regions (Pojar and others 1987, Rowe 1972). Viereck and Dyrness (1980) published a preliminary report on a State-wide system for a hierarchical classification of plant communities, in which forest types and communities are distinguished at levels IV and V of the hierarchy, respectively. Although some communities described by Viereck and Dyrness (1980) for southeast coastal and interior Alaska are represented on the Kenai Peninsula, the rugged relief of this area and its geographic position combine to produce a relatively unique mosaic of forest communities. Nineteen forest types are described for the Susitna River Basin (USDA Soil Conservation Service 1986), which lies on the north end of Cook Inlet and directly north of the Kenai Peninsula; however, a detailed analysis of forest community composition is not given. The present study provided a preliminary classification of the forest communities found in timberland on the Kenai Peninsula.

Materials and Methods

Selecting Sample Stands and Subplots

In 1987, scientists at the Forestry Sciences Laboratory in Anchorage, Alaska, conducted a timber inventory on the Kenai Peninsula by using a two-stage sampling design. A total of 5,597 photo points was systematically located on 1:60,000-scale high-altitude photographs by using a 3.19- by 2.84-centimeter grid. Photo interpretation was used to classify the vegetation at each grid position. The vegetation analysis was limited to a study of timberland (volume increment > 1.4 cubic meters per hectare per year); 688 of the 5,597 points (12.3 percent) were classified as timberland. Stands classified as timberland were further classified by overstory cover type. A stand was classified as coniferous if overstory conifer cover was at least 75 percent, and similarly for broadleaf cover. If neither conifer nor broadleaf cover was at least 75 percent, then the stand was classified as mixed (conifer-broadleaf). Within the timberland class, 129 randomly selected photo points (18.7 percent of 688 timberland points) were selected for field survey, such that the number of sample points visited in each forest cover type was proportional to its frequency in the 5,597-point sample (number of points surveyed in coniferous, mixed, and broadleaf types was 82, 40, and 7, respectively).

Stands surrounding each photo sample point were examined by using variable-radius plots typically arranged in a five-point pattern; the first subplot was centrally located, and subplot numbers two, three, four, and five were located 100 meters to the north, east, south, and west, respectively, of the central subplot. If subplot number two, three, four, or five fell within an area having vegetative cover not representative of the larger stand, the location of the subplot was shifted 100 meters to the east, south, west, or north, respectively.

For each plot, at least six of the largest stand dominants in or near the variable-radius plots were selected as site trees to estimate stand age for inventory purposes. In mixed-species stands, at least two site trees were selected for each species represented in the stand overstory. For this study, only spruce (Picea spp.) species selected as site trees were used to compute stand age, so that stand age (as used here) refers only to the age of the spruce component of a stand.

Measuring Site Variables

Plot elevation was recorded at the center of the first subplot in 30-meter interval classes. Slope position, percent slope, and aspect were measured at each of the five subplot centers, and an average value obtained for the plot. Possible values for slope position of a plot were derived from four basic subplot values: "flat terrain", "midslope", "ridgetop", and "rolling terrain". An "average" value for slope position of a plot was obtained by applying two rules: If at least four of the five subplots were classified as having the same basic slope position value, then this slope position value was assigned to the whole plot. If less than four subplots were classified with the same basic slope position value, then an intermediate value of slope position was assigned. If, for example, there were two occurrences of "flat terrain", and three occurrences of "midslope", then the plot would be classified as "lower slope." The complete set of basic and derived values for slope position of a plot was: "flat terrain," "lower slope," "midslope," "upper slope," "ridgetop," and "rolling terrain."

Edaphic features recorded at each subplot were depth to the top of an impermeable layer, or saturated soil (if present) and depth to the bottom of the moss, fibrous organic matter, and decomposed organic matter layers. All values were recorded to the nearest centimeter. If neither an impermeable layer nor saturated soil was encountered within the top 50 centimeters of a soil profile, then a value of 99 centimeters was recorded. The five subplot values for each variable were averaged to obtain corresponding plot values.

Measuring Plant Cover

Overstory—Overstory trees within each variable-radius plot were selected by using a prism with a basal area factor equal to four square meters per hectare. An individual was considered part of the overstory if tree diameter at breast height (d.b.h. at 137 centimeters) was at least 10 centimeters. Tree species, d.b.h., and crown radius were recorded for each sample tree. Percent cover by tree species within a subplot was calculated by summing the products of crown area for each tree and the number of individuals per hectare that a given tree represented. The five subplot values obtained for each tree species were averaged to estimate percent overstory cover of a tree species within the stand.

Saplings—Estimates of percent cover for saplings of each tree species (d.b.h. at least 2.5 centimeters and less than 10 centimeters) were obtained from five 1.5-meter fixed-radius plots centered on the variable-radius timber plot centers. As with overstory trees, percent cover was calculated from the total crown area of the estimated number of saplings of a species per hectare. In the vegetation analyses described below, overstory and sapling cover were combined into a single cover estimate per species; this will be referred to as overstory cover.

Understory—Percent cover for mosses, lichens, forbs, grasses, shrubs, and tree reproduction (d.b.h. less than 2.5 centimeters) was based on average estimates from two 5.64-meter fixed-radius plots (0.01 hectares each) centered on the first two variable-radius timber plots. Because the original intent of the inventory in obtaining understory cover estimates was to characterize floristic composition in three dimensions, cover values for each species were separately estimated within several variable-height intervals up to 5 meters above the soil line. To use such data for describing the composition of the flora, it was necessary to express the percent cover of a species as its maximum cover value within the set of layers. In practical application, however, the only growth form with cover estimates expected to vary from standard estimation methods is tall shrubs. For tall shrubs, cover estimates used in this paper may slightly underestimate percent cover as usually estimated.

Plant identification

Hulten's (1968) treatment of Alaska flora was used for plant identification and as the source for taxonomic authorities for herbaceous vascular plants (table 1). Authorities for woody plants, mosses, and lichens were Viereck and Little (1972), Crum and others (1973), and Hale and Culberson (1970), respectively. Trees were always identified to the species level. Grasses, mosses, and lichens were usually identified only to the generic level. Shrubs and forbs were not consistantly identified by field personnel to the species level. In preliminary tabulations of plant cover on a plot, whenever members of a genus were not consistantly identified to species level, cover values were summed to obtain a single cover estimate for the genus (table 1).

Vegetation Classification

Sample stands were classified into forest communities with the computer program TWINSPAN (Hill 1979, Hill and others 1975). Gauch (1982) presents a good discussion of the TWINSPAN algorithm and its merits. Briefly, the TWINSPAN classification technique is a polythetic strategy, which means information on all species composing the stands-by-species matrix is used in the analysis. The TWINSPAN algorithm is hierarchical and divisive, meaning that the procedure starts by considering all stands as a single group. The program uses a slight modification of the reciprocal averaging algorithm (Hill 1973) as a basis for making successive dichotomous divisions on a set of sample stands. The TWINSPAN algorithm is used as follows (Gauch 1982):

1. Ordinate the sample stands using reciprocal averaging.
2. Refine the ordination by weighting the species such that those characteristic of the axis extremes are given greatest weight.
3. Divide the ordination axis near its origin such that species fidelity to membership in one of the two subsets is maximized.
4. Repeat steps 1-3 on the resulting subsets of stands.

Table 1—Incidence and combinations of plant species included in analysis of the Kenai Peninsula vegetation data

Scientific name[a]	Common name	Incidence
		Number[b]
Overstory:		
Betula papyrifera Marsh.	Paper birch	85
Picea glauca (Moench) Voss	White spruce	59
Picea X lutzii Little	Lutz spruce	83
Picea mariana (Mill.) B.S.P.	Black spruce	26
Picea sitchensis (Bong.) Carr.	Sitka spruce	12
Populus tremuloides Michx.	Trembling aspen	34
Populus trichocarpa Torr. & Gray.	Black cottonwood	12
Tsuga mertensiana (Bong.) Sarg.	Mountain hemlock	36
Shrubs:		
Alnus Mill.	Alder	31
Arctostaphylos uva-ursi (L.) Spreng.	Bearberry	1
Betula nana L.	Dwarf arctic birch	12
Cornus canadensis L.	Bunchberry	105
Cornus stolonifera Michx.	American dogwood	2
Cornus suecica L.	Swedish dwarf cornel	36
Empetrum nigrum L.	Black crowberry	47
Ledum groenlandicum Oeder	Labrador tea	10
Ledum palustre decumbens (Ait.) Hult.	Northern Labrador tea	4
Linnaea borealis L.	Twin flower	89
Menziesia ferruginea Sm.	Rusty menziesia	67
Oplopanax horridum	Devil's club	32
Ribes L.	Currant	30
Rosa acicularis Lindl.	Prickly rose	33
Rubus L.	Raspberry	35
Rubus pedatus Sm.	Five-leaf bramble	80
Salix L.	Willow	43
Sambucus racemosa L.	Red elderberry	12
Shepherdia canadensis (L.) Nutt.	Buffaloberry	1
Sorbus S.F. Gray	Mountain ash	11
Spiraea beauverdiana Schneid.	Beauverd spirea	34
Vaccinium L.	Blueberry	64
Vaccinium vitis-idaea L.	Lowbush cranberry	64
Viburnum edule (Michx.) Raf.	Highbush cranberry	34
Forbs:		
Achillea borealis Bong.	Common yarrow	2
Aconitum delphinifolium DC.	Monkshood	2
Actaea rubra (Ait.) Willd.	Baneberry	4
Anemone L.	Anemone	1
Aquilegia formosa Fisch.	Columbine	1
Aruncus sylvester Kostel.	Goatsbeard	1
Athyrium filix-femina (L.) Roth	Lady fern	10
Caltha L.	Marsh marigold	1
Castilleja unalaschcensis (Cham. & Schlecht.) Malte	Yellow painbrush	1
Circaea alpina L.	Enchanted nightshade	1
Dryopteris dilatata (Hoffm.) Gray	Spinulose shield fern	52
Epilobium L.	Willow-herb	61
Equisetum L.	Horsetail	36
Galium L.	Bedstraw	3
Gentiana amarella L.	Gentian	1
Geocaulon lividum (Richards.) Fern.	Northern commandra	29
Geranium erianthum DC.	Northern geranium	17
Gymnocarpium dryopteris (L.) Newm.	Oak-fern	86
Listera cordata (L.) R. Br.	Heart twyblade	4
Lupinus L.	Lupine	10
Moneses uniflora (L.) Gray	Single delight	4
Pedicularis labradorica Wirsing	Labrador lousewort	1
Polemonium L.	Jacob's ladder	2
Polystichum braunii (Spenn.) Fee	Prickly shield fern	2
Potentilla L.	Cinquefoil	2

See footnotes at end of table.

Table 1—continued

Scientific name[a]	Common name	Incidence
		Number[b]
Forbs:		
Pyrola L.	Wintergreen	46
Sanguisorba L.	Burnet	34
Smilacina Desf.	Solomon seal	1
Stellaria L.	Chickweed	1
Streptopus Michx.	Twisted stalk	33
Thelypteris phegopteris (L.) Slosson	Beech fern	4
Tiarella trifoliata L.	Three leaf lace flower	7
Trientalis europaea L.	Starflower	40
Veratrum viride Ait.	False hellebore	6
Viola L.	Violet	2
Grasses:		
Calamagrostis Adans.	Reed bentgrass	61
Carex L.	Sedge	4
Mosses and lichens:		
Alectoria sp.	Lichen	26
Aulacomnium sp.	Bog moss	42
Cetraria sp.	Lichen	2
Cladina sp.	Lichen	15
Cladonia sp.	Lichen	37
Dicranum sp.	Moss	63
Drepanocladus sp.	Moss	2
Hepaticae	Liverwort	12
Hylocomium sp.	Feathermoss	121
Hypnum sp.	Moss	9
Hypogmnia sp.	Lichen	39
Lobaria sp.	Lichen	8
Lycopodium sp.	Clubmoss	88
Mnium sp.	Moss	58
Nephroma sp.	Lichen	25
Parmelia sp.	Lichen	6
Peltigera sp.	Veined lichen	80
Pleurozium schreberi (Brid.) Mitt.	Schreber's moss	100
Polytrichum sp.	Moss	81
Ptilium sp.	Plume moss	70
Rhytidiadelphus sp.	Moss	64
Sphagnum sp.	Sphagnum moss	55
Stereocaulon sp.	Lichen	3
Usnea sp.	Lichen	41

[a] Absence of a species name indicates that plant specimens were not identified to species on at least 1 plot and that all such species were combined at the generic level for analysis.

[b] Number of inventory plots in which a genus or species was observed.

In my analysis, a maximum of five levels of division were specified. Division on a subset of stands was terminated if a subset contained less than six stands. The default cut points of TWINSPAN for defining cover classes (for example, 0, 2, 5, 10, and 20 percent cover) were used so that the classification of plots would not be too heavily influenced by overstory composition. The species composition of each pair of subsets at the lowest level of division was compared by using the ordered species-by-stands matrix produced by TWINSPAN; low-level divisions were eliminated when distinctions in species composition were trivial. Names for vegetation communities were constructed from the names of species (or genera) both dominant and characteristic in each of the four vegetation layers (for example, tree, shrub, forb-grass, and lichen-moss layers). No distinction was made between low- and tall-shrub layers, and mosses and lichens were treated as a single vegetation layer.

Results and Discussion

A diagram of the results of the TWINSPAN analysis shows the forest communities that could be usefully distinguished and the relations of these communities to each other in the hierarchical classification (fig. 2). The names of the forest communities that correspond to the numerical designations for TWINSPAN subsets (TSS) are given in table 2. Communities will generally be referred by the TSS designations (for example, TSS *0000). Average species cover and constancy values by community are presented in tables 3 and 4, respectively. Average total cover by vegetation layer within a community is summarized in table 5. General site and stand attributes of the plots included in each community are summarized in table 6. Cover values reported for stand overstories as reported in table 5 were not used as a basis for the overstory cover classes in table 6. Percent overstory cover in table 5 includes both trees classified as growing stock (d.b.h. at least 10.0 centimeters) and saplings. Cover classes in table 6 are based on percent cover of overstory trees only. Basic edaphic features of the forest communities are summarized in table 7.

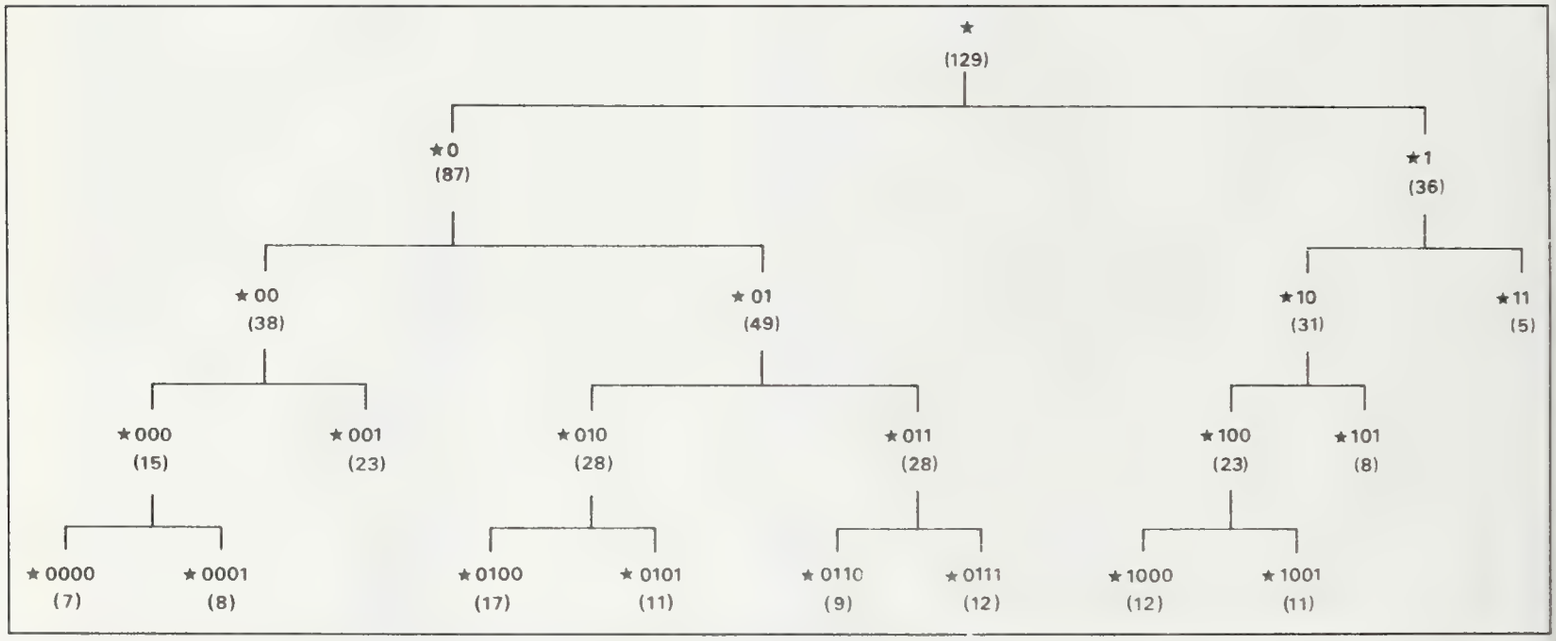

Figure 2—Hierarchical classification of forest communities produced by the program TWINSPAN. The correspondence between community names and TWINSPAN subset designations is presented in table 2. Individual plots included in a particular community are delineated in the appendix.

Table 2—Correspondence between TWINSPAN group designations and forest communities for vegetation data from the Kenai Peninsula

Number of plots	TWINSPAN designation	Plant community name
7	*0000	Closed Picea mariana/Cornus canadensis-Vaccinium vitis-idaea/Peltigera spp.-Rhytidiadelphus spp.
8	*0001	Open Picea glauca-Picea mariana/Empetrum nigrum-Vaccinium vitis-idaea/Peltigera spp.-Pleurozium spp.
24	*001	Closed Picea glauca-Betula papyrifera/Cornus canadensis-Vaccinium vitis-idaea/Epilobium spp./Pleurozium spp.
17	*0100	Closed Picea X lutzii-Betula papyrifera/Menziesia ferruginea-Rubus pedatus/Gymnocarpium dryopteris/ Peltigera spp.-Pleurozium spp.
12	*0101	Closed Picea glauca-Betula papyrifera/Menziesia ferruginea-Rubus pedatus/Gymnocarpium dryopteris/ Lycopodium spp.-Pleurozium spp.
9	*0110	Closed Picea glauca-Picea X lutzii/Linnea borealis-Rubus pedatus/Sanguisorba spp.-Calamagrostis spp./ Lycopodium spp.-Ptilium spp.
12	*0111	Closed Picea X lutzii/Rubus pedatus-Salix spp./Sanguisorba spp.-Calamagrostis spp./Mnium spp.
15	*1000	Closed Picea X lutzii-Tsuga mertensiana/Cornus canadensis-Menziesia ferruginea/Sphagnum spp.
12	*1001	Closed Picea X lutzii-Tsuga mertensiana/Menziesia ferruginea-Oplopanax horridum/Dryopteris dilatata/ Rhytidiadelphus spp.-Sphagnum spp.
8	*101	Closed Picea sitchensis/Oplopanax horridum-Rubus pedatus/Dryopteris dilatata-Gymnocarpium dryopteris/ Mnium spp.-Rhytidiadelphus spp.
5	*11	Open Picea X lutzii-Populus trichocarpa/Alnus spp.-Oplopanax horridum/Dryopteris dilatata

Table 3—Average species cover by forest community[a]

Species	TWINSPAN forest community designation[b]										
	*0000	*0001	*001	*0100	*0101	*0110	*0111	*1000	*1001	*101	*11
	Percent cover[c]										
Overstory:											
Betula papyrifera	20.6	17.7	45.4	25.9	51.1	26.2	4.5	10.4	4.5	.	1.2
Picea glauca	14.9	37.5	35.6	10.2	30.1	34.4	24.0	1.4	.	Tr	11.1
Picea X lutzii	16.6	.	22.8	52.3	21.2	35.3	66.6	36.2	56.1	25.4	33.2
Picea mariana	44.4	44.2	8.1	1.9	3.0	.	.	Tr	.	.	.
Picea sitchensis	.	.	.	.	.	8.2	.	3.4	1.2	52.3	3.2
Populus tremuloides	18.9	1.3	19.7	4.3	.1	4.5	.	.	.	.	.
Populus trichocarpa	.	.	2.0	0.3	2.4	.	.	.	.	.	18.6
Tsuga mertensiana	.	.	.	11.5	.	.	Tr	68.5	47.2	10.6	6.8
Understory:											
Betula papyrifera	.4	.5	.7	.1	.2	1.7	2.2	.1	.1	.	.
Picea glauca	1.0	.7	2.3	.3	1.0	.4	.2	.1	.	.	.
Picea X lutzii	.	.	.9	.3	.	.9	2.6	1.1	.	.6	.
Picea mariana	14.9	6.2	.7	.	.	.	.	.	.	.	.
Picea sitchensis	.	.	.	.	.	.	.	.3	.1	.6	.
Populus tremuloides	.4	.	.3	.	.	.	.	.	.	.	.
Populus trichocarpa	.	.	.	.	.	.	.	.	.	.	
Tsuga mertensiana	.	.	.	3.9	.	.	.	10.5	1.8	1.1	.
Shrubs:											
Alnus spp.	.	.6	Tr	1.2	7.1	.	2.2	1.8	7.4	1.2	29.2
Arctostaphylos uva-ursi	.	.2	.	.	.	.	.	.	.	.	.
Betula nana	2.3	1.1	.6	.2	.	.8	.2	.	.	.	.
Cornus canadensis	3.7	5.6	8.0	5.3	5.8	3.9	2.8	3.5	2.2	1.4	.
Cornus stolonifera	.	.	.	.	.2	.	.	.	.	.	.
Cornus suecica	.	1.4	1.4	1.3	2.7	.8	1.7	.8	.	.1	.
Empetrum nigrum	11.1	11.1	1.5	4.7	.	2.0	2.5	2.9	.	.	.
Ledum groenlandicum	1.0	.6	.9	.3	.	.	.2	.	.	.	.
Ledum palustre decumbens	.	3.4	.	.	.	.	.	.	.	.	.
Linnaea borealis	3.7	2.9	6.5	5.5	5.3	8.0	4.5	1.7	.1	.1	.8
Menziesia ferruginea	.	10.6	Tr	19.5	21.1	.7	3.3	13.1	12.5	2.2	.2
Oplopanax horridum	.	.	.1	.	2.0	.	.1	.2	6.1	17.0	19.4
Ribes spp.	.	.7	.1	.3	.2	1.3	.7	.1	.5	.	1.6
Rosa acicularis	1.3	1.1	2.5	.8	2.0	.	.1	.	.	.	.
Rubus pedatus	.	.	.	8.4	8.8	16.1	14.5	3.3	8.1	18.5	4.4
Other Rubus spp.	.6	2.5	1.0	.8	.3	1.1	2.4	.2	.1	.7	.
Salix spp.	1.0	4.5	2.5	1.0	.1	4.2	6.0	.4	.1	.	.
Sambucus racemosa	.	.	.	.	1.0	.1	.	.	.2	.1	2.4
Shepherdia canadensis	.	.	.6	.	.	.	.	.	.	.	.
Sorbus spp.	.	.	Tr	.3	.2	.	.2	.3	.2	.	.
Spiraea spp.	2.6	2.0	.4	2.1	.2	2.8	3.5	.	.	.	.
Vaccinium vitis-idaea	26.3	17.5	19.8	7.3	.	.	3.7	1.7	.	.	.
Other Vaccinium spp.	3.9	5.4	1.0	.7	3.4	3.9	2.2	6.2	4.4	14.7	.
Viburnum edule	.	.	2.3	.5	3.7	.9	.1	.5	.1	.1	.
Forbs:											
Achillea spp.	.	.	.1	.	.	.1	.	.	.	.	.
Aconitum delphinifolium	.	.	.	.	.	.	.3	.	.	.	.
Actaea rubra	.	.	Tr	.	.	.	.2	.	.2	.	.
Anemone spp.	.	.	.	.	.	.	.6	.	.	.	.
Aquilegia spp.	.	.	.	.	.	.	.2	.	.	.	.
Aruncus sylvester	.	.	.	.	.	.	.	.	.1	.	.
Athyrium filix.femina	.	.	.	.1	.1	.2	.6	.	.5	2.6	1.2
Caltha spp.	.	.	.	.	.	.	.	.	.	.1	.
Castilleja unalaschcensis	.	.	.	.	.	.	.1	.	.	.	.
Circaea alpina	.	.	.	.	.	.	.2	.	.	.	.
Dryopteris dilatata	.	.	.	1.3	5.5	6.1	2.7	1.0	6.2	15.2	20.4
Epilobium spp.	.7	.7	2.8	.7	1.3	2.9	1.9	.3	.2	.	.6
Equisetum spp.	.1	2.5	Tr	4.8	3.7	1.7	9.7	.	.2	.1	3.2

See footnotes at end of table.

Table 3—continued

Species	TWINSPAN forest community designation[b]										
	*0000	*0001	*001	*0100	*0101	*0110	*0111	*1000	*1001	*101	*11
	Percent cover[c]										
Forbs:											
Galium spp.	.	.	.	.	.1	.	.	.	.	.	.4
Gentiana amarella	.	.	.	.	.	.	.1	.	.	.	.
Geocaulon lividum	1.9	2.7	3.8	.3	.2	.1	.	.2	.	.	.
Geranium erianthum	.	.	.1	.	.1	1.1	1.5	.	.	.	.
Gymnocarpium dryopteris	.	1.1	6.1	9.6	15.2	17.2	9.7	2.1	3.1	15.7	9.2
Listera cordata	.	.	.	.	.	.	.5	.	.	.9	.
Lupinus spp.	.1	.4	.2	.	.	.1	2.3	.	.	.	.
Moneses uniflora	.	.	.	.	.	.	.2	.	.	1.1	.
Pedicularis labradorica	.	.	Tr	.	.	.	.	.	.	.	.
Polemonium spp.	.	.	.1	.2	.	.	.	.	.	.	.
Polystichum braunii	.	.	.	.	.2	.	.	.	.2	.	.
Potentilla spp.	.	.2	.	.1	.	.	.	.	.	.	.
Pyrola spp.	.	.	.8	1.1	3.1	1.7	3.4	.3	.5	.1	.
Sanguisorba spp.	.	.7	.6	.5	.7	7.2	5.3	.1	.2	.	.4
Smilacina spp.	.	.	.	.	.	.	.	.	.1	.	.
Stellaria spp.	.	.	.	.	.	.	.1	.	.	.	.
Streptopus spp.	.	.	Tr	.3	.7	1.8	2.7	.	.6	.9	.2
Thelypteris phegopteris	.	.	.	.	.	.	.	.1	.2	6.1	.
Tiarella spp.	.	.	.	.	.	.	.	.	.3	5.2	.
Trientalis europaea	.	.	.7	.6	1.7	.3	2.1	.	.2	.	1.2
Veratrum viride	.	.	.	.	.	.	4.7	.	.	.	.
Viola spp.	.	.	Tr	.	.	.	.	.	.1	.	.
Grasses:											
Calamagrostis spp.	.4	1.4	1.2	3.4	4.7	9.7	5.6	.1	.7	.6	2.8
Carex spp.	.3	.	.	.	.	.	.2	.1	.	.	.
Mosses and lichens:											
Alectoria spp.	1.0	.1	.1	.8	.3	.5	.5	.1	.8	.	.
Aulacomnium spp.	2.1	.	.5	.5	.9	.5	2.3	3.2	1.2	.7	2.2
Cetraria spp.	.	.	.	.	.	.	.	.1	.	.	.
Cladina spp.	.9	3.9	.2	.1	.	.	.2	.1	.	.2	.
Cladonia spp.	2.1	.1	.6	.5	.2	.3	.2	.7	.2	.1	.
Dicranum spp.	1.0	.2	.2	1.3	.7	1.0	1.7	3.4	2.3	3.5	.2
Drepanocladus spp.	.	.	Tr	.	.3	.	.	.	.	.	.
Hepaticae	.	.	.	.1	.1	.2	.2	.8	.1	.2	.
Hylocomium spp.	13.0	18.0	23.3	20.8	13.8	18.0	15.7	21.7	19.7	14.4	.2
Hypnum spp.	.	.	.2	.	.2	.9	.2	.	.	.	.8
Hypogmnia spp.	.4	.4	.2	.2	.5	.7	.4	.3	.2	.2	.4
Lobaria spp.	.1	.	.	.1	.1	.1	.	.1	.1	.4	.
Lycopodium spp.	-	3.9	4.7	5.1	12.5	11.9	6.6	1.4	1.6	3.0	1.4
Mnium spp.	.	.1	.1	1.7	1.7	3.2	8.3	.9	3.2	17.0	6.8
Nephroma spp.	.3	4.5	.1	.3	.3	.4	.8	.1	.	.	.
Other lichen	.6	.	.3	.2	.2	.1	.3	.3	.2	.5	.4
Other moss	2.3	.5	3.3	2.3	2.7	.7	5.0	.5	8.0	5.5	4.8
Parmelia spp.	.	.2	.1	.1	.1	.	.	.1	.	.	.
Peltigera spp.	4.0	2.4	2.8	2.0	.3	.5	1.2	1.5	.2	.	.
Pleurozium schreberi	19.9	31.1	21.4	16.4	13.2	15.3	17.1	14.2	2.9	4.4	.2
Polytrichum spp.	3.4	1.0	2.9	2.9	1.2	5.1	8.6	1.5	1.6	.9	.
Ptilium spp.	2.3	.1	3.5	4.8	4.5	6.3	.6	2.3	3.7	.5	.
Rhytidiadelphus spp.	23.3	.	7.2	7.3	1.8	6.8	8.1	10.6	3.8	30.0	.4
Sphagnum spp.	3.4	20.0	.3	10.4	.1	1.2	9.8	13.9	6.4	2.1	.
Usnea spp.	.	.	.	.	.1	.	.	.1	.	.1	.

[a] Tabulated values are summarized from tables 8a-18a in the appendix.

[b] Descriptive names for forest communities are presented in table 2.

[c] Tr indicates that a species was present in a given TWINSPAN group, but that its average cover value was < 0.1 percent.

Table 4—Species constancy by forest community[a]

Species	TWINSPAN forest community designation[b]										
	*0000	*0001	*001	*0100	*0101	*0110	*0111	*1000	*1001	*101	*11
	Constancy[c]										
Overstory:											
Betula papyrifera	100	75	92	82	100	100	48	33	33	-	20
Picea glauca	57	75	79	41	83	44	33	13	-	12	40
Picea X lutzii	43	-	58	88	33	67	75	87	100	50	60
Picea mariana	100	87	29	18	8	-	-	7	-	-	-
Picea sitchensis	-	-	-	-	-	-	-	13	25	75	20
Populus tremuloides	86	25	83	12	17	22	-	-	-	-	-
Populus trichocarpa	-	-	25	6	17	-	-	-	-	-	60
Tsuga mertensiana	-	-	-	35	-	-	8	100	92	25	20
Understory:											
Betula papyrifera	14	25	33	12	17	33	17	7	8	-	-
Picea glauca	29	37	46	6	42	11	17	7	-	-	-
Picea X lutzii	-	-	12	23	-	44	58	20	-	25	-
Picea mariana	100	62	21	-	-	-	-	-	-	-	-
Picea sitchensis	-	-	-	-	-	-	-	7	8	25	-
Populus tremuloides	29	-	12	-	-	-	-	-	-	-	-
Populus trichocarpa	-	-	-	-	-	-	-	-	-	-	-
Tsuga mertensiana	-	-	-	23	-	-	-	93	50	12	-
Shrubs:											
Alnus spp.	-	12	4	12	50	-	17	27	58	37	100
Arctostaphylos uva-ursi	-	12	-	-	-	-	-	-	-	-	-
Betula nana	29	25	12	6	-	22	17	-	-	-	-
Cornus canadensis	100	100	96	100	92	78	58	93	58	50	-
Cornus stolonifera	-	-	-	-	17	-	-	-	-	-	-
Cornus suecica	14	37	50	29	33	33	33	20	-	12	-
Empetrum nigrum	57	87	33	71	-	33	67	33	-	-	-
Ledum groenlandicum	29	25	12	12	-	-	8	-	-	-	-
Ledum palustre decumbens	-	50	-	-	-	-	-	-	-	-	-
Linnaea borealis	57	75	87	100	92	100	75	60	8	12	20
Menziesia ferruginea	-	37	4	82	92	11	33	100	100	62	20
Oplopanax horridum	-	-	8	-	33	-	8	13	83	100	100
Ribes spp.	-	25	8	35	17	55	50	7	33	-	40
Rosa acicularis	43	25	62	29	58	-	8	-	-	-	-
Rubus pedatus	-	-	-	94	83	100	100	80	92	100	40
Other Rubus spp.	14	37	29	18	17	44	83	7	8	37	-
Salix spp.	43	87	50	23	8	33	92	7	8	-	-
Sambucus racemosa	-	-	-	-	25	11	-	-	17	12	100
Shepherdia canadensis	-	-	4	-	-	-	-	-	-	-	-
Sorbus spp.	-	-	4	18	8	-	17	20	8	-	-
Spiraea spp.	29	37	17	53	17	67	67	-	-	-	-
Vaccinium vitis-idaea	100	100	100	76	-	-	50	40	-	-	-
Other Vaccinium spp.	29	37	29	23	58	55	83	67	75	87	-
Viburnum edule	-	-	62	23	75	22	8	7	8	12	-
Forbs:											
Achillea spp.	-	-	4	-	-	11	-	-	-	-	-
Aconitum delphinifolium	-	-	-	-	-	-	17	-	-	-	-
Actaea rubra	-	-	4	-	-	-	8	-	17	-	-
Anemone spp.	-	-	-	-	-	-	8	-	-	-	-
Aquilegia spp.	-	-	-	-	-	-	8	-	-	-	-
Aruncus sylvester	-	-	-	-	-	-	-	-	8	-	-
Athyrium filix-femina	-	-	-	6	8	11	8	-	17	25	40
Caltha spp.	-	-	-	-	-	-	-	-	-	12	-
Castilleja unalaschcensis	-	-	-	-	-	-	8	-	-	-	-
Circaea alpina	-	-	-	-	-	-	8	-	-	-	-
Dryopteris dilatata	-	-	-	35	67	67	50	40	83	75	80
Epilobium spp.	29	50	75	47	57	100	75	7	17	-	20
Equisetum spp.	14	25	4	53	17	78	92	-	8	12	20

See footnotes at end of table.

Table 4—continued

Species	TWINSPAN forest community designation[b]										
	*0000	*0001	*001	*0100	*0101	*0110	*0111	*1000	*1001	*101	*11
						Constancy[c]		Forbs:			
Galium spp.	-	-	-	-	8	-	-	-	-	-	40
Gentiana amarella	-	-	-	-	-	-	8	-	-	-	-
Geocaulon lividum	43	62	67	6	17	11	-	7	-	-	-
Geranium erianthum	-	-	4	-	8	67	75	-	-	-	-
Gymnocarpium dryopteris	-	25	54	71	100	100	92	53	75	87	60
Listera cordata	-	-	-	-	-	-	8	-	-	37	-
Lupinus spp.	14	12	8	-	-	11	42	-	-	-	-
Moneses uniflora	-	-	-	-	-	-	8	-	-	37	-
Pedicularis labradorica	-	-	4	-	-	-	-	-	-	-	-
Polemonium spp.	-	-	4	6	-	-	-	-	-	-	-
Polystichum braunii	-	-	-	-	8	-	-	-	8	-	-
Potentilla spp.	-	12	-	6	-	-	-	-	-	-	-
Pyrola spp.	-	-	42	41	75	67	75	13	17	12	-
Sanguisorba spp.	-	25	12	18	33	100	83	7	8	-	20
Smilacina spp.	-	-	-	-	-	-	-	-	8	-	-
Stellaria spp.	-	-	-	-	-	-	8	-	-	-	-
Streptopus spp.	-	-	4	23	50	55	75	-	25	50	20
Thelypteris phegopteris	-	-	-	-	-	-	-	7	17	12	-
Tiarella spp.	-	-	-	-	-	-	-	-	8	75	-
Trientalis europaea	-	-	37	35	67	33	83	-	17	-	40
Veratrum viride	-	-	-	-	-	-	50	-	-	-	-
Viola spp.	-	-	4	-	-	-	-	-	8	-	-
Grasses:											
Calamagrostis spp.	14	37	46	65	67	100	92	7	25	25	20
Carex spp.	29	-	-	-	-	-	8	7	-	-	-
Mosses and lichens:											
Alectoria spp.	57	12	12	29	17	44	25	7	25	-	-
Aulacomnium spp.	29	-	25	29	42	44	42	47	33	25	40
Cetraria spp.	-	-	-	-	-	-	-	13	-	-	-
Cladina spp.	43	50	8	6	-	-	17	7	-	25	-
Cladonia spp.	86	12	21	41	25	11	17	60	17	12	-
Dicranum spp.	57	25	17	41	50	67	50	80	75	75	20
Drepanocladus spp.	-	-	4	-	8	-	-	-	-	-	-
Hepaticae	-	-	-	12	8	22	8	20	8	25	-
Hylocomium spp.	86	100	100	100	100	100	92	100	83	100	20
Hypnum spp.	-	-	12	-	17	22	8	-	-	-	20
Hypogmnia spp.	43	37	17	23	50	44	42	33	17	25	20
Lobaria spp.	14	-	-	6	8	11	-	7	8	25	-
Lycopodium spp.	-	62	71	88	92	89	75	60	50	75	40
Mnium spp.	-	12	8	41	42	78	100	40	75	87	40
Nephroma spp.	14	50	8	23	33	33	42	13	-	-	-
Other lichen	14	-	25	18	17	11	25	20	25	50	40
Other moss	86	37	71	65	83	33	92	40	83	100	60
Parmelia spp.	-	12	8	6	8	-	-	7	-	-	-
Peltigera spp.	100	87	87	94	8	55	83	73	17	-	-
Pleurozium schreberi	57	100	92	82	92	78	83	80	50	62	20
Polytrichum spp.	86	62	79	71	33	67	75	60	67	37	-
Ptilium spp.	57	12	67	71	58	100	25	60	67	12	-
Rhytidiadelphus spp.	86	-	25	53	42	67	33	67	83	87	20
Sphagnum spp.	29	50	25	65	8	11	58	87	67	25	-
Usnea spp.	-	-	-	-	8	-	-	7	-	12	-

[a] Tabulated values are summarized from tables 8a-18a in the appendix.

[b] Descriptive names for forest communities are presented in table 2.

[c] Tr indicates that a species was present in a given TWINSPAN group, but that its average cover value was < 0.1 percent. A dash indicates complete absence of a species from a TWINSPAN group.

Table 5—Average total species cover by forest community and canopy layer[a]

TWINSPAN designation[b]	Average total cover				
	Overstory[c]	Reproduction	Shrub	Forb[d]	Moss and lichen
			Percent		
*0000	115.3	16.7	57.6	3.0	80.1
*0001	99.5	7.5	71.4	5.0	86.6
*001	133.5	4.8	49.3	15.6	71.9
*0100	106.4	4.6	60.1	19.6	77.7
*0101	107.8	1.2	64.2	32.7	56.0
*0110	108.8	3.0	46.6	40.7	74.0
*0111	95.0	3.0	49.7	49.2	87.8
*1000	119.9	11.9	36.7	4.1	77.9
*1001	109.0	2.0	41.9	12.6	56.0
*101	100.7	2.4	56.6	48.2	84.0
*11	74.0	0	58.0	36.8	17.8

[a] Cover values are summarized from tables 8a-18a in the appendix.

[b] Descriptive names for forest communities are presented in table 2.

[c] Percent cover for overstory vegetation includes saplings.

[d] Percent grass cover is not included in forb cover.

Detailed descriptions of the 11 forest communities (fig. 2) are presented in the appendix (tables 8 through 18). The suffixes a, b, and c, used on appendix table numbers, identify tables for species composition, stand and site characteristics, and basic edaphic features, respectively, of each plot included in a particular community. Within some communities, considerable heterogeneity among plots included in a particular community is apparent in both composition of stand overstories (tables 8a to 18a) and other stand and site characteristics (tables 8b to 18b). Because all vegetation layers had the potential to contribute more or less equally to the classification procedure by virtue of the default cut points noted previously, this heterogeneity was not unexpected. The intent in allowing understory species to assume weights comparable to those in the overstory was to delineate the communities more indicative of a site's vegetative cover potential, and not to relate understory structure to overstory structure.

Table 6—General site and stand characteristics of Kenai vegetation plots by forest community[a]

TWINSPAN type[b]	Number of plots	Elevation			Principal cover[c]		Stands with closed canopies[d]	Stand age[e]			Typical slope position[f]	Slope	Aspect[g]
		Average	Minimun	Maximum	Conifer	Hardwood		Average	Minimum	Maximum			
		Meters			Percent			Years				Percent	
*0000	7	109	30	183	57	29	57	74	25	133	Mid-rolling (86)	11	W (43)
*0001	8	160	61	274	87	0	0	103	42	155	Flat-rolling (62)	9	NW (62)
*001	24	106	30	183	21	4	62	96	47	151	Low-mid (67)	6	W (58)
*0100	17	174	61	427	65	0	71	117	61	152	Low-mid (76)	10	W (53)
*0101	12	112	30	244	25	17	67	103	60	138	Low-mid (67)	12	W (50)
*0110	9	149	30	274	44	0	22	99	63	137	Low-mid (67)	8	W (44)
*0111	12	348	183	488	92	0	50	109	87	144	Mid (67)	11	W (58)
*1000	15	235	61	457	87	7	93	126	49	238	Mid (100)	30	N (73)
*1001	12	239	91	427	100	0	92	147	55	230	Mid (92)	40	S (67)
*101	8	110	30	244	100	0	75	143	89	215	Mid (75)	25	W (75)
*11	5	189	30	396	80	20	40	130	69	178	Mid (60)	14	SW (60)

[a] Tabulated values are summarized from tables 8b-18b in the appendix.

[b] Descriptive names for forest communities are given in table 2.

[c] A stand was classified as conifer if coniferous overstory trees contributed at least 75 percent of overstory tree cover, and similarly for stands classified as hardwood. A stand was classified as mixed if neither overstory conifers nor hardwoods contributed at least 75 of overstory cover. Tabulated values are the percentage of stands within a forest community classed as either conifer or hardwood. The percentage of mixed stands can be obtained by subtraction.

[d] A stand was classified as closed, open, or woodland if overstory tree cover was at least 60, 25, or 10 percent, respectively. Only 1 stand classified as woodland occurs in the data (TWINSPAN group *11), so that the percentage open stands in a forest community can be obtained by subtraction.

[e] Stand age was calculated as the average age of as many as 6 coniferous site trees. Site trees were individuals that had maintained a dominant or codominant position for most of their lives. When possible, site trees were selected from those trees included in the variable radius plot talleys. If too few site trees was obtained from the variable plots, additional neighboring trees meeting the site tree criteria were selected if possible.

[f] Possible values for slope (topographic) position were flat, low(er slope), mid (slope), upper (slope), ridgetop, and rolling (terrain). Tabulated values are those observed for the majority of plots within a forest community. If the most common topographic position did not represent a majority of the plots, then a combination of the 2 most numerous topographic positions (for example, low-mid) has been used. Numbers in parentheses indicate the percentage of plots in the community that are described by the latter topographic position.

[g] Possible values are the cardinal compass directions (N, S, E, and W) or combinations (for example, NW, SE). Numbers in parentheses indicate the percentage of plots in the community.

Table 7—Edaphic characteristics of the Kenai vegetation plots by forest community[a]

TWINSPAN type[b]	Mean layer thickness[c]				First mineral horizon			Saturated soil		Impervious layer	
	Moss	Fibrous organics	Decomposed organics	Rooting[d]	Soil texture[e]	Coarse fragments[f]	Mean depth[g]	Frequency[h]	Mean depth[g]	Frequency[h]	Mean depth[g]
	Centimeters				Percent	Percent	Cm	Percent	Cm	Percent	Cm
*0000	3.8	2.0	4.7	10.2	67	25	32	14.3	85.0	0	.
*0001	4.1	6.7	3.6	6.7	55	0	32	12.5	63.0	12.5	37.0
*001	2.9	4.6	3.6	9.6	57	8	27	8.3	76.5	12.5	76.7
*0100	3.8	4.1	5.2	9.2	79	35	32	11.8	84.0	17.6	86.7
*0101	2.7	5.5	3.9	8.9	29	17	34	8.3	52.0	16.7	60.0
*0110	2.4	4.7	2.4	7.8	62	0	34	0	.	0	.
*0111	3.3	3.1	3.4	10.0	82	8	28	16.7	68.0	16.7	67.5
*1000	4.0	7.5	6.4	11.4	72	27	35	40.0	70.2	13.3	75.0
*1001	3.9	6.4	6.4	11.5	80	50	31	33.3	59.5	16.7	79.5
*101	2.4	3.8	4.0	11.9	77	25	26	25.0	77.5	12.5	83.0
*11	1.4	6.0	5.0	16.2	67	60	31	20.0	59.0	40.0	81.5

[a] Edaphic characteristics are summarized from tables 8c-18c in the Appendix.

[b] Descriptive names of the forest communities are given in table 2.

[c] Mean depth to bottom of a layer was computed for each plot included in a forest community, based on 5 soil profiles (tables 8c-18c). A grand mean depth to the bottom of each layer in a forest community was computed from tables 8c-18c. Mean layer thickness for a community was computed as the difference between consecutive grand mean depths except in the case of rooting depth (see below).

[d] Thickness of the rooting zone was computed as the difference between depth of the fibrous organic layer and depth of rooting, and thus includes thickness of the decomposed organic layer.

[e] Frequency of soils within a community with a loam or finer texture.

[f] Frequency of plots within a community in which the course mineral fraction (particles > 2 mm diameter) accounted for more than 15 percent of soil volume in the first mineral horizon.

[g] Depth is with respect to top of the moss layer. Depth to occurrence of an impervious layer or saturated soil was recorded in each of the 5 subplots of a plot. Soil pits were excavated to a depth of 50 centimeters. If an impervious layer or saturated soil was not encountered in the top 50 centimeters of the soil profile, then depth to occurrence was entered as 99; otherwise, the actual depth to occurrence was recorded. Plot values for depth to occurrence were computed as the average of the 5 subplot values.

[h] Frequency of plots in a forest community within which an impervious layer or saturated soil was encountered in the top 50 centimeters of the soil profile.

Physiographic Characteristics of the Communities

Plots included in TSS *0000 and TSS *0001, are typical of the Kenai Lowlands physiographic region (fig. 1). They occur at low elevations on shallow slopes and rolling terrain and closely resemble black spruce taiga communities of interior Alaska (tables 6 and 8b). A few plots included in tnese two communities occur on or next to benches within the Kenai Mountains physiographic region. Plots included in TSS *101 are similar in vegetation composition and physiography to Sitka spruce communities of southeast Alaska. On the Kenai Peninsula, this community occurs in both the Kenai Lowlands and Kenai Mountains physiographic regions, but it is restricted to the maritime climatic zone of both regions. TSS *11 consists of riparian Lutz spruce-black cottonwood communities that occur over a fairly broad elevational range, primarily within the Kenai Mountains region.

The seven remaining TSSs occur within the Kenai Mountains region (fig. 1), and all have either Lutz spruce or white spruce, or both, as the principal component of the overstory (tables 2 and 3). Four groups of plant communities can be distinguished within these TSSs. The first group includes TSS *001, TSS *0100, TSS *0101, and TSS *0110, and occurs approximately equally on westerly and easterly exposures at lower to middle elevations and in lower- to mid-slope positions (table 6). TSS *0111, TSS *1000, and TSS *1001 generally occur at high elevations and in midslope positions. However, TSS *0111 occurs more or less equally on westerly and easterly exposures, TSS *1000 and TSS *1001 occur predominantly on northerly and southernly exposures, respectively.

Basic Edaphic Characteristics of the Communities

A fairly clear distinction between TSSs prefixed by *0 (the left-side members of fig. 1) and those prefixed by *1 (the right-side members of fig. 1) exists in several basic edaphic features (table 7). Fibrous organic and decomposed organic layers are generally better developed in the *1 subset than in the *0 subset. Extent of rooting is also consistantly greater in the *1 subset. All communities included in the *1 subset have a moderate to high frequency of soils in which the coarse mineral fraction (material > 2 millimeters in diameter) exceeds 15 percent by volume in the first mineral horizon. In contrast, only two of the seven communities included in the *0 subset had a moderate incidence of soils in which coarse fragments composed a substantial fraction of the first mineral horizon. The incidence of either saturated soils or impervious layers was low in the *0 subset. In the *1 subset, the occurrence of saturated soils or impervious layers, or both, is much higher, which suggests that the *1 subset represents communities generally occurring on wetter sites. Within the *1 subset, TSS *1000 and TSS *1001 represent cool, wet sites with thick fibrous and decomposed organic layers indicative of slower rates of decomposition. These two communities are also the only two described in this study in which mountain hemlock is the primary, or at least a major, component of the overstory. The thickness of organic layers in TSS *101 and TSS *11 are comparable to those in the *0 subset. In contrast to differences in edaphic characteristics noted above, consistant trends across the *0 and *1 subsets are not apparent for thickness of the moss layer, soil texture, and depth of the first mineral horizon.

Stand Structure and Species Composition of the Communities

Closed-open *Picea mariana/Cornus canadensis-Vaccinium vitis-idaea/Peltigera* spp.-*Rhytidiadelphus* spp. (TSS *0000)—Open- and closed-canopy stands occur in roughly equal numbers in TSS *0000 (tables 6 and 8b). Black spruce, paper birch, and trembling aspen all occur with high constancy in the overstory, but percent cover is highly variable (table 8a). White and Lutz spruce are common in the overstory, but the two species occurred together on only one of seven plots. Reproduction of all tree species except black spruce is limited, and most stands included in this community probably represent mid to late seral stages. The shrub layer is dominated by lowbush cranberry. Bunchberry occurs with 100 percent constancy in the shrub layer but with an average cover of only 3.7 percent (tables 5 and 8a). Relatively few species occur in the forb layer and cover is consistantly low; total cover averages only 3.0 percent (tables 5 and 8a). The moss-lichen layer is relatively rich in species, and total cover averages 80.1 percent. *Hylocomium* spp. are common in this community, but have little diagnostic value, because they ar e common over a range of communities (tables 3 and 4). *Peltigera* spp. and *Rhytidiadelphus* spp. were considered useful indicators for this community. The community appears to be similar to the Closed *Picea glauca-Picea mariana/Salix* spp./*Vaccinium vitis-idaea/lichen* community described by Yari (1983) for interior Alaska.

Open *Picea glauca-Picea mariana/Empetrum nigrum-Vaccinium vitis- idaea/ Peltigera* spp.-*Pleurozium* spp. (TSS *0001)—All stands in TSS *0001 have open canopies (tables 6 and 9b), but the species composition of stands is similar to that for TSS *0000 (tables 3, 4, 8a, and 9a). Differences appeared to be sufficient to justify recognizing a distinct community. In particular, Lutz spruce does not occur in this community at all, and the average cover and constancy of trembling aspen are much lower (table 9a). As with the previous community type, most stands in this community are representative of mid to late seral stages. Total percent cover values in the shrub layer are also similar, and lowbush cranberry dominates the shrub layer, but bunchberry, willow species, and black crowberry also appear with high constancy in this community. Forb layers are also similar, but TSS *0001 is characterized by both greater species richness and greater average total cover. Finally, by way of comparison, *Pleurozium schreberi* replaces *Rhytidiadelphus* spp. in this community. Five *Picea glauca-Picea mariana* communities are described for interior Alaska (Viereck 1979, Yari 1983), but none matches the present description.

Closed *Picea glauca-Betula papyrifera/Vaccinium vitis-idaea/Cornus canadensis/Pleurozium* spp. (TSS *001)—With a total of 24 plots, TSS *001 is the most common forest community on the Kenai Peninsula (table 6). Both open and closed canopy structures are common (table 10b). The overstory is composed principally of white spruce and paper birch and, to a lesser extent, trembling aspen (table 10a). White spruce makes up the majority of tree reproduction. In several stands, Lutz spruce is the dominant conifer species. The apparent interchangeability of Lutz and white spruce in this and other communities discussed here is indicative of a high degree of genetic continuity between the two species as a result of genetic introgression (Copes and Beckwith 1977).

Total overstory cover is generally high in TSS *001, with percent cover ranging up to 205 percent as a result of high cover values in both conifers and broadleaved trees (tables 5 and 10a). Seventy-five percent of the plots examined were classified as having a mixed conifer-broadleaf cover type (tables 6 and 10b). Most stands in this community represent midseral stages when paper birch is replaced by spruce species. Because of the high overstory cover, shrub and forb cover values are somewhat low when compared to other white or Lutz spruce communities; average total cover in these layers is 49.3 and 15.6 percent, respectively (tables 5 and 10a). Lowbush cranberry and bunchberry are the dominant shrub species, but twinflower is also common. Fireweed species and northern commandra are frequent components of the forb layer. *Hylocomium* spp., and *Pleurozium schreberi* account for most cover in the moss-lichen layer. *Peltigera* spp. occur with a constancy of 87 percent, but cover averages only 2.8 percent. Correspondence with previously described Closed *Picea glauca-Betula papyrifera* communities[3, 4] (Viereck 1975) is relatively poor.

Closed *Picea* × *lutzii-Betula papyrifera/Menziesia ferruginea-Rubus pedatus/Gymnocarpium dryopteris/Peltigera* spp.-*Pleurozium* spp. (TSS *0100)—The majority of stands in TSS *0100 have a closed canopy in which the primary component is Lutz spruce (tables 6 and 11b). In 2 of the 17 plots in this community, the principal overstory component was white spruce (table 11a). Plots included in this community generally represent midseral stages, when birch is replaced by spruce species. Total overstory cover averages 106 percent; paper birch is frequently an important overstory species. Reproduction is generally sparse. In the four plots with substantial reproduction, the reproduction is primarily mountain hemlock, whose presence is indicative of a late seral stage. In species presence, this community shows a high degree of similarity to TSS *1000 (table 3), in which mountain hemlock is a primary component of the overstory. It is possible that those stands included here that have significant mountain hemlock reproduction more properly belong to TSS *1000. However, the stable community type for many of the stands included in TSS *0100 may be similar both in species composition and cover to that of TSS *1000.

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[3] Foote, M. Joan. 1976. Classification, description, and dynamics of plant communities following fire in the taiga of interior Alaska. Final report for the Bureau of Land Management. 211 p. On file with: U.S. Department of Agriculture, Forest Service, Institute of Northern Forestry, 308 Tanana Drive, Fairbanks, Alaska 99775-5500.

[4] Jorgenson, M. Torre; Slaughter, Charles W.; Viereck, Leslie A. [In preparation]. Relation of vegetation and terraine in the Caribou-Poker Creek Research Watershed, central Alaska. Gen. Tech. Rep. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 89 p. Draft version on file with: Institute of Northern Forestry, 308 Tanana Drive, Fairbanks, Alaska 99775-5500.

Rusty menziesia and five-leaf bramble dominate the shrub layer in which total cover averages 60.1 percent (tables 5 and 11a). Twinflower, black crowberry, bunchberry, and lowbush cranberry are common in this layer as well but at lower densities. The principal forb species in this community is oak-fern. Horsetail species and *Calamagrostis* spp. are also commonly present with constancies of 53 and 65 percent, respectively. As in several other communities, *Hylocomium* spp. consistantly contribute in large proportion to total cover in the moss-lichen layer. Peltigera spp. and *Pleurozium schreberi* are considered diagnostic for the community, but *Lycopodium* spp., *Polytrichum* spp., *Ptilium* spp., and *Sphagnum* spp. also commonly occur. As with the previous community, this one also does not correspond well with previously described Closed *Picea glauca-Betula papyrifera* communities.

Closed *Picea glauca-Betula papyrifera/Menziesia ferruginea-Rubus pedatus/Gymnocarpium dryopteris/Lycopodium* spp.-*Pleurozium* spp. (TSS *0101)—With respect to stand age, canopy closure, total overstory cover, and physiographic features, TSS *0101 is very similar to TSS *0100 (tables 5 and 6), but 58 percent of the plots in TSS *0101 were classified as mixed conifer-broadleaf, and the primary conifer species is white spruce. In 25 percent of the plots, Lutz spruce occurs instead of white spruce (table 12a). Trembling aspen is rare in this community, and mountain hemlock does not occur at all. The shrub layer in this community is similar to that of TSS *0100 in that rusty menziesia, five-leaf bramble, and bunchberry are the primary species. Twinflower and highbush cranberry, rather than lowbush cranberry, are common. The principal forb species is oak-fern. Other common members of the forb layer are spinulose shield fern, wintergreen species, starflower, and *Calamagrostis* spp. *Lycopodium* spp. and *Pleurozium* spp. are characteristic species of the moss-lichen layer. *Hylocomium* spp. occur with 100 percent constancy, but percent cover is much lower than in TSS *0100 (tables 3 and 4). This community does not seem to be previously described.

Open *Picea glauca-Picea* × *lutzii/Linnea borealis-Rubus pedatus/Sanguisorba* spp.-*Calamagrostis* spp./*Lycopodium* spp.-*Ptilium* spp. (TSS *0110)—Most stands in TSS *0110 have an open canopy structure (tables 6 and 13b), but saplings contribute substantially to total cover, which averages 109 percent (tables 5 and 13a). Coniferous and mixed conifer-broadleaf cover types are about equally represented. Paper birch occurred on all plots with generally low cover. In two plots, paper birch was the primary overstory cover species. Lutz and white spruce both contribute about 35 percent of overstory cover and occur with constancies of 67 and 44 percent, respectively. Both species were present in 25 percent of the plots. Despite the generally open canopy structure, reproduction is low in this community, possibly as a result of the consistant occurrence of *Calamagrostis* spp. TSS *0110 generally represents a rather narrow range of mid seral stages.

Total shrub cover averages 46.6 percent (tables 5 and 13a). Five-leaf bramble and twinflower both occur with 100 percent constancy and together comprise the majority of shrub species cover, but bunchberry is also relatively common. Fireweed species, oak-fern, burnet species, and Calamagrostis spp. all occur in the forb layer with 100 percent cover (table 13a). Of the latter, burnet species and Calamagrostis spp. were considered as diagnostic for this community. Horsetail species are also common as are, to a lesser extent, spinulose shield fern, northern geranium, and wintergreen species. Several species are also very common in the moss-lichen layer; they include *Hylocomium* spp., *Lycopodium* spp., *Mnium* spp., *Pleurozium schreberi*, and *Ptilium* spp. *Dicranum* spp., and *Rhytidiadelphus* spp. are also fairly common. Considering only species that occur with high constancy, the forb and moss-lichen layers of this community are the most floristically diverse among the communities described here. The community TSS *0110 does not correspond well with any of the seven Open *Picea glauca* communities previously described for the interior (Viereck 1979, Yari 1983).

Open-Closed *Picea* × *lutzii/Rubus pedatus-Salix* spp./*Sanguisorba* spp.-*Calamagrostis* spp./*Mnium* spp. (TSS *0111)—Open- and closed-canopy stands are equally represented in TSS *0111 (tables 6 and 14b). Saplings frequently represent a major contribution to total cover. Lutz spruce is the primary component of the overstory, but stands with white spruce overstories also occur in the community (table 14a). The predominant cover type is coniferous. In contrast to TSS *0101 and TSS *0110, paper birch is only a minor component of the overstory in this community (table 3) and often is not present at all (table 4). Stand ages are similar for all three of these communities (table 6), so that the lower occurrence of paper birch is probably not indicative of a later seral stage for TSS *0111. Instead, the general absence of birch is most likely due to stands in this community occurring at much higher elevations (table 6).

Total shrub cover in TSS *0111 averages 49.7 percent (tables 5 and 14a), and five-leaf bramble is again the most important species contributing to cover in both percent cover and constancy (table 14a). Willow species are also diagnostic for the community. Although average cover for willows is only 6 percent, willow species occur with a much higher constancy than they do in TSS *0110 (tables 4 and 14a). As in TSS *0110, horsetails, oak-fern, and *Calamagrostis* spp. appear with high constancy in this community (tables 4, 13a, and 14a). The relative abundances differ considerably, with percent cover of horsetails being more than three times higher in this community; but percent cover of oak-fern and grasses is only about half that in TSS *0110. Fireweed species, northern geranium, and wintergreen occur with about equal constancy in both communities as well. Percent cover values for the latter two species are comparable, but percent cover of fireweed averages three times higher in TSS *0110. *Mnium* spp. are characteristic of the moss-lichen layer. Besides *Hylocomium* spp., species common to the community that contribute substantially to total cover are *Lycopodium* spp., *Pleurozium schreberi*, and *Polytrichum* spp. The Open *Picea glauca/Salix bebbiana/Rosa acicularis/Equisetum* spp.-*Epilobium* spp./lichen community of Yari (1983) is somewhat similar to the present community although the principle overstory species here is Lutz spruce and Rosa acicularis is generally absent.

Closed *Picea* × *lutzii-Tsuga mertensiana/Cornus canadensis-Menziesia ferruginea/Sphagnum* spp. (TSS *1000)—TSS *1000 and the two discussed next are the most consistant in canopy closure and forest type because they are composed primarily of closed coniferous stands (table 6). Average total overstory cover in this community is 120 percent (table 15a). Mountain hemlock occurs with 100-percent constancy and is the principal cover in the overstory of older stands; in younger stands Lutz spruce forms the majority of the overstory cover (tables 15a and 15b). Older stands in this community are probably at or near a stable canopy structure. Two stands in which the spruce component is Sitka spruce are also included in this community. Paper birch is absent from most stands, but in plot 143, where the spruce component averages 49 years of age, paper birch accounts for 100 percent cover. Most of the reproduction in this community is also mountain hemlock and averages 10.5 percent.

Total shrub cover is relatively low at an average of only 36.7 percent (tables 5 and 15a). Rusty menziesia is the most important species in cover and constancy (tables 15a and 15b). Five-leaf bramble and bunchberry occur with constancies of 80 and 92 percent, respectively, but average cover for these species is only about 3 percent. Total forb cover is extremely low compared to most other communities described in this study, and no species has high constancy. The moss-lichen layer is composed primarily of *Hylocomium* spp., *Pleurozium schreberi*, and *Sphagnum* spp., but *Rhytidiadelphus* spp. also commonly occur at moderate cover values.

Closed *Picea* × *lutzii-Tsuga mertensiana/Menziesia ferruginea-Oplopanax horridum/Dryopteris dilatata/Mnium* spp.-*Rhytidiadelphus* spp. (TSS *1001)—General overstory structure in TSS *1001 is very similar to that for TSS *1000) because it is almost exclusively a closed coniferous type (tables 5 and 16a). Species composition is very similar, with the contribution of mountain hemlock to total overstory cover tending to be greater in older stands (tables 16a and 16b). Older stands in this community probably also represent stable communities. Tree reproduction is primarily mountain hemlock.

The shrub layer in TSS *1001 is similar to that for TSS *1000; however, devil's club also appears in this community with an average cover of 6 percent and a constancy of 83 percent (tables 3, 4, 15a, and 16a). Spinulose shield fern and oak-fern are the principal species in the forb layer. The principal species in the moss-lichen layer are *Hylocomium* spp., *Mnium* spp., and *Rhytidiadelphus* spp. Dicranum spp. are also common in the moss-lichen layer. Only one mountain hemlock community is described for Alaska (Martin 1989). The current community, which includes a significant spruce component in the overstory, is generally similar to that described by Martin (1989) but probably represents a somewhat earlier seral stage.

Closed *Picea sitchensis/Oplopanax horridum-Rubus pedatus/Dryopteris dilatata-Gymnocarpium dryopteris/Mnium* spp.-*Rhytidiadelphus* spp. (TSS *101)—Stands in TSS *101 usually have closed canopies and are, perhaps, exclusively coniferous (tables 6 and 17b). In roughly half the stands, the overstory is pure Sitka spruce (table 17a). Stands dominated by mountain hemlock or Lutz spruce are also included in this community, but, as is the case with introregression between white and Lutz spruce, Lutz spruce trees in this community tend to be more like Sitka spruce in morphology. Broad-leaved species are absent or at least rare in TSS *101 and reproduction is generally low. Stands included in this community represent mid to late seral stages.

Devil's club and five-leaf bramble comprise the majority of shrub cover, which averages 56.6 percent (tables 5 and 17a). Spinulose shield fern and oak-fern each occur with about 15 percent cover and account for about 60 percent of total cover within the forb layer (table 17a). *Tiarella* spp. are the only other species that occur with a high degree of constancy in the forb layer. In the moss-lichen layer, *Hylocomium* spp., *Mnium* spp., and *Rhytidiadelphus* spp. occur with high constancy and together account for almost 75 percent of the cover. Martin (1989) has described three *Picea sitchensis/Oplopanax horridum* communities for southeast and south-central Alaska. The Closed *Picea sitchensis/Vaccinium* spp./*Oplopanax horridum* community corresponds quite well with the present description.

Open *Picea* × *lutzii-Populus trichocarpa/Alnus* spp.-*Oplopanax horridum/Dryopteris dilatata* (TSS *11)—TSS *11 is a rather small, heterogeneous collection of flood-plain and riparian stands that are quite variable in structure and composition of the overstory (tables 18a and 18b). It is, however, the only community where black cottonwood assumes any consistant importance as a component of the overstory (tables 3 and 4). Species presence and cover are considerably more uniform in the lower vegetation layers. For example, alder species, devil's club, and red elderberry occur with 100-percent constancy in the shrub layer of this community (table 18a). These three species together constitute almost 90 percent of total shrub cover. It is also the only community in which alder species and red elderberry achieve a high degree of constancy (table 4). Spinulose shield fern averages 20 percent cover in the forb layer and is the only species in this layer with high constancy. No species in the moss-lichen layer can be considered typical of the community. In fact, no cover was recorded for this layer in plots 23 and 31. No detailed descriptions exist for white spruce-black cottonwood or Lutz spruce-black cottonwood communities, but a general description of Open *Picea glauca-Populus trichocarpa* communities in the Susitna River Basin (USDA Soil Conservation Service 1986) is similar to that presented here.

Conclusions

Several forest communities described here have not been described previously, although all are compatible with the level IV classes of Viereck and Dyrness (1980). Viereck and Dyrness recently have completed a revision of the original classification system for Alaska that recognizes additional communities and includes level V community descriptions.[5] Communities described here that include white or Lutz spruce as the principal overstory species seem to be sufficiently distinct from communities previously described in Alaska to warrant inclusion in a future revision to the vegetation classification system.

Community classification may be interesting as an end in itself, but more often interest in classification extends to developing hypotheses about the relation of community composition to environmental gradients (Grieg-Smith 1983). In addition, community classification can have important and direct implications for forest management, because community composition and the environmental factors influencing it can affect both optimum management and use of timberland. For example, Reynolds and Hard (in press) have estimated risk and hazard of spruce beetle (*Dendroctonus rufipennis* Kirby) attack for forest communities on the Kenai Peninsula. Numerous other applications to forest management on the peninsula could similarly be developed on the basis of community type.

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Literature Cited

Copes, Donald L.; Beckwith, Roy C. 1977. Isoenzyme identification of *Picea glauca, P. sitchensis*, and *P. lutzii* populations. Botanical Gazette. 138: 512-521.

Crum, H.A.; Steere, W.C.; Anderson, L.E. 1973. A new list of mosses of North America north of Mexico. Bryologist. 76: 85-130.

Gauch, Hugh G. Jr. 1982. Multivariate analysis in community ecology. New York: Cambridge University Press. 298 p.

Grieg-Smith, P. 1983. Quantitative plant ecology. Berkeley, CA: University of California Press. 359 p.

Hale, M.E., Jr.; Culberson, W.L. 1970. A fourth checklist of the lichens of the continental United States and Canada. Bryologist. 73: 499-543.

[5] Personal communication, February 5, 1989, L.A. Viereck, research ecologist, and C.T. Dyrness, research soil scientist, U.S. Department of Agriculture, Forest Service, Institute of Northern Forestry, 308 Tanana Drive, Fairbanks, Alaska 99775-5500.

Hill, M.O. 1973. Reciprocal averaging: an eigenvector method of ordination. Journal of Ecology. 61: 237-249.

Hill, M.O. 1979. TWINSPAN: A FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. Ithaca, NY: Cornell University. 90 p.

Hill, M.O.; Bunce, R.G.H.; Shaw, M.W. 1975. Indicator species analysis, a divisive polythetic method of classification, and its application to a survey of native pine woods in Scotland. Journal of Ecology. 63: 597-613.

Hulten, E. 1968. Flora of Alaska and neighboring territories. Stanford, CA: Stanford University Press. 1,008 p.

Martin, G.C.; Johnson, B.L.; Grant, U.S. 1915. Geology and mineral resources of Kenai Peninsula, Alaska. Washington, DC: U.S. Department of the Interior, U.S. Geological Survey. 243 p.

Martin, Jon R. 1989. Vegetation and environment in old growth forests of northern southeast Alaska: a plant association classification. Flagstaff: Arizona State University. 221 p. M.S. thesis.

Pewe, Tres L. 1975. Quaternary geology of Alaska. Prof. Paper 835. [Location of publisher unknown]: U.S. Department of the Interior, U.S. Geological Survey. 12 p.

Pojar, J.; Klinka, K.; Meidinger, D. V. 1987. Biogeoclimatic ecosystem classification in British Columbia. Forest Ecology and Management. 22: 119-154.

Reynoids, K.M.; Hard, J.S. [in press]. Risk and hazard of spruce beetle attack in unmanaged stands on the Kenai Peninsula, Alaska, under epidemic conditions. Forest Ecology and Management.

Rowe, J.S. 1972. Forest regions of Canada. Publ. 1300. [Location of publisher unknown]: Canada Department of the Environment. Canadian Forestry Service. [not paged].

Selkregg, L.L., comp. 1974. Alaska regional profiles: south-central region. [Location of the publisher unknown]: The University of Alaska, Arctic Environmental Information and Data Center. 255 p. In cooperation with: The Joint Federal-State Land Use Planning Commission for Alaska.

U.S. Department of Agriculture, Soil Conservation Service. 1986. Timber and vegetation resources of the Susitna River Basin, Alaska. Fort Richardson, AK: U.S. Army Publication Center. 224 p. In cooperation with: State of Alaska, Department of Natural Resources.

Viereck, Leslie A. 1975. Forest ecology of the Alaska taiga. In: Proceedings of the Circumpolar Conference on Northern Ecology; 1975 September 15-18; Ottawa, ON: National Research Council of Canada; 1975: 1-1 to 1-22.

Viereck, Leslie A. 1979. Characteristics of treeline plant communities in Alaska. Holartic Ecology. 2: 228-238.

Viereck, Leslie A.; Dyrness, C.T. 1980. A preliminary classification system for vegetation of Alaska. Gen. Tech. Rep. PNW-106. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 38 p.

Viereck, Leslie A.; Little, Elbert L., Jr. 1972. Alaska trees and shrubs. Agric. Handb. 410. Washington, DC: U.S. Department of Agriculture. 265 p.

Yari, John. 1983. Forest community classification of the Porcupine River drainage, interior Alaska, and its application to forest management. Gen. Tech. Rep. PNW-154. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 68 p.

Appendix

Table 8a—Species composition of Kenai vegetation plots included in the Closed *Picea mariana/Cornus canadensis-Vaccinium vitis-idaea/Peltigera* spp.-*Rhytidiadelphus* spp. community, TWINSPAN subset *0000

Species	Plots							Average cover	Constancy
	30	38	40	42	56	129	135		
	Percent cover[a]							Percent[b]	
Overstory:									
Betula papyrifera	Tr	13	Tr	Tr	67	32	31	20.6	100
Picea glauca	32	-	-	23	17	32	-	14.9	57
Picea mariana	35	99	57	57	14	18	31	44.4	100
Picea X lutzii	-	-	25	-	54	-	37	16.6	43
Populus tremuloides	Tr	-	48	8	31	30	15	18.9	86
Total	68	112	130	88	183	112	114	115.3	
Reproduction:									
Betula papyrifera	-	-	-	-	-	3	-	0.4	14
Picea glauca	4	-	-	3	-	-	-	1.0	29
Picea mariana	7	53	6	6	14	15	3	14.9	100
Populus tremuloides	-	-	1	-	-	2	-	0.4	29
Total	11	53	7	9	14	20	3	16.7	
Shrubs:									
Betula nana	-	-	-	12	-	-	4	2.3	29
Cornus canadensis	5	1	8	5	2	3	2	3.7	100
Cornus suecica	-	-	-	-	1	-	-	0.1	14
Empetrum nigrum	11	-	-	18	-	26	23	11.1	57
Ledum groenlandicum	6	-	-	-	1	-	-	1.0	29
Linnaea borealis	7	-	-	1	-	16	2	3.7	57
Rosa acicularis	3	-	-	-	5	1	-	1.3	43
Rubus spp.	-	-	-	-	-	-	4	0.6	14
Salix spp.	-	-	4	1	-	2	-	1.0	43
Spiraea spp.	-	-	-	-	1	-	17	2.6	29
Vaccinium vitis-idaea	19	22	39	28	43	27	6	26.3	100
Other Vaccinium spp.	25	0	0	0	0	2	0	3.9	29
Total	76	23	51	65	53	77	58	57.6	
Forbs:									
Geocaulon lividum	5	-	-	2	-	6	-	1.9	43
Epilobium spp.	2	-	3	-	-	-	-	0.7	29
Equisetum spp.	-	-	2	-	-	-	-	0.1	14
Lupinus spp.	-	-	1	-	-	-	-	0.1	14
Total	7	-	6	6	-	6	-	3.0	
Grasses:									
Calamagrostis spp.	3	-	-	-	-	-	-	0.4	14
Carex spp.	-	-	1	1	-	-	-	0.3	29
Mosses and lichens:									
Alectoria spp.	1	-	-	1	2	-	3	1.0	57
Aulacomnium spp.	-	12	-	-	-	-	3	1.1	29
Cladina spp.	-	1	-	4	-	-	1	0.9	43
Cladonia spp.	1	5	6	1	-	1	1	1.1	86
Dicranum spp.	-	3	-	-	1	1	2	1.0	57
Hylocomium spp.	5	8	-	5	39	8	26	13.0	86
Hypogmnia spp.	-	-	1	1	-	-	1	0.4	43
Other lichen species	4	-	-	-	-	-	-	0.6	14
Lobaria spp.	-	-	1	-	-	-	-	0.1	14
Other moss species	7	3	1	2	1	2	-	2.3	86
Nephroma spp.	-	-	-	-	-	-	2	0.3	14

See footnotes at end of table.

Table 8a—continued

Species	Plots 30	38	40	42	56	129	135	Average cover	Constancy
	- - - - - - Percent cover[a] - - - -							- - Percent[b] - -	
Mosses and lichens:									
Peltigera spp.	2	5	6	5	4	2	4	4.0	100
Pleurozium schreberi	-	30	-	60	29	-	20	19.9	57
Polytrichum spp.	4	-	8	1	4	4	3	3.4	86
Ptilium spp.	-	-	3	-	5	5	3	2.3	57
Rhytidiadelphus spp.	58	3	41	8	-	52	1	23.3	86
Sphagnum spp.	-	-	-	-	4	-	20	3.4	29
Total	82	70	67	88	89	75	90	80.1	

[a] Tr indicates that the cover of a species within a plot was < 1 percent cover. A dash indicates that the species was absent.

[b] Tr indicates that the average cover of a species was < 0.1 of 1 percent.

Table 8b—Site characteristics of Kenai vegetation plots belonging to the Closed *Picea mariana/Vaccinium vitis-idaea/Cornus canadensis/Peltigera* spp.-*Rhytidiadelphus* spp. community, TWINSPAN subset *0000

Plot	Elevation	Principal cover[a]	Closure[b]	Stand age	Slope position	Slope	Aspect
	Meters			Years		Percent	
30	182.9	Conifer	Open	133	Mid	23.0	SW
38	121.9	Conifer	Closed	25	Rolling	2.6	None
40	61.0	Mixed	Open	NA	Rolling	8.0	None
42	30.5	Conifer	Closed	60	Rolling	1.0	None
56	91.4	Hardwood	Closed	112	Low	4.8	NW
129	152.4	Hardwood	Closed	80	Mid	32.2	SE
135	121.9	Conifer	Open	108	Mid	4.8	NW

[a] A stand was classified as conifer if coniferous overstory trees contributed at least 75 percent of tree cover, and similarly for hardwoods. A stand was classified as mixed if neither overstory conifers nor hardwoods contributed at least 75 percent of tree cover.

[b] A stand was classified as closed, open, or woodland if overstory tree cover was at least 60, 25, or 10 percent, respectively. Stands with < 10 percent cover were considered to be nonforest land.

[c] Stand age was calculated as the average of as many as 6 coniferous site trees. Site trees were individuals that had maintained a dominant or codominant canopy position for most of their lives. When possible, site trees were selected from those trees included in the variable-radius plots. If an insufficient number of site trees was obtained from the variable-radius plots, then additional neighboring trees meeting the site tree criterion were selected if possible.

[d] Possible values for slope (topographic) position were flat, low(er slope), mid(slope), upper (slope), and rolling (terrain).

[e] Possible values for aspect are the cardinal compass directions (N, S, E, and W) or combinations (for example, NW, SE)

Table 8c—Soil characteristics of Kenai vegetation plots belonging to the Closed *Picea mariana/Vaccinium vitis-idaea/Cornus canadensis/Peltigera* spp.-*Rhytidiadelphus* spp. community, TWINSPAN subset *0000

Plot	Depth of:[a]						Top mineral horizon		
	Impervious layer[b]	Saturated soil[b]	Root depth	Moss layer	Fibrous organic	Decomposed organic	Texture[c]	Coarse fragments[d]	Depth[a]
	Centimeters								Cm
30	85	-	12	4	7	11	SiL-SL	VL-L	24
38	-	-	14	2	5	8	SL	VL	28
40	-	-	13	2	5	9	SiL-L	VL	31
42	-	-	14	5	8	11	SL	VL-L	39
56	-	-	27	6	10	13	SiL	VL	29
129	-	-	21	4	8	12	SiL-SL	VL	32
135	-	-	11	4	8	10	SiL	VL	42

[a] All depths were relative to the top of the moss layer on the soil surface.

[b] A dash indicates that a specific type of soil feature was not observed within the first 50 centimeters below the soil surface.

[c] Soil texture was determined for each of the 5 subplots. Texture classes were CL = clay loam, SiL = silt loam, L = loam, SL = sandy loam, and LS = loamy sand (or sand). For each plot, if the same texture class was recorded on at least 4 of the subplots, then that texture class is reported for the plot, otherwise a range of texture classes is indicated.

[d] The mineral fraction > 2 mm diameter was classed as coarse fragments. Coarse fragment content was recorded as very low (VL < 15 percent), low (15 percent < L < 30 percent), moderate (30 percent < M < 60 percent), or high (H > 60 percent).

Table 9a—Species composition of Kenai vegetation plots included in the Open *Picea glauca-Picea mariana/Empetrum nigrum-Vaccinium vitis-idaea/Peltigera* spp.-*Pleurozium* spp. community, TWINSPAN subset *0001

Species	Plots								Average cover	Constancy
	22	24	25	27	29	79	133	142		
	Percent cover[a]									Percent[b]
Overstory:										
Betula papyrifera	9	31	-	10	-	28	53	11	17.7	75
Picea glauca	68	64	-	-	61	64	36	7	37.5	75
Picea mariana	49	4	100	74	48	39	-	40	44.2	87
Populus tremuloides	-	10	-	-	Tr	-	-	-	1.3	25
Total	116	109	100	84	109	131	89	58	99.5	
Reproduction:										
Betula papyrifera	-	1	-	3	-	-	-	-	0.5	25
Picea glauca	2	-	-	-	3	1	-	-	0.7	37
Picea mariana	-	3	14	8	17	-	-	8	6.2	62
Total	2	4	14	11	20	1	0	8	7.5	
Shrubs:										
Alnus spp.	-	-	-	-	-	-	-	5	0.6	12
Arctostaphylos uva-ursi	-	-	-	-	-	-	-	2	0.2	12
Betula nana	8	-	-	-	-	-	-	1	1.1	25
Cornus canadensis	10	8	6	1	1	4	8	7	5.6	100
Cornus suecica	3	-	-	-	1	-	-	7	1.4	37
Empetrum nigrum	14	12	-	10	7	21	10	15	11.1	87
Ledum groenlandicum	-	-	-	1	-	-	-	4	0.6	25
Ledum palustre decumbens	11	-	1	-	9	-	-	6	3.4	50
Linnaea borealis	4	1	-	1	1	9	7	-	2.9	75
Menziesia ferruginea	-	1	-	29	-	-	55	-	10.6	37
Ribes spp.	1	-	-	-	-	-	-	5	0.7	25
Rosa acicularis	-	-	-	-	-	-	1	8	1.1	25
Rubus spp.	15	3	-	-	-	-	2	-	2.5	37
Salix spp.	3	7	1	1	12	1	-	11	4.5	87
Spiraea spp.	7	8	-	-	1	-	-	-	2.0	37
Vaccinium vitis-idaea	6	16	18	7	22	42	27	2	17.5	100
Other Vaccinium spp.	16	0	0	0	18	0	0	9	5.4	37
Total	98	56	26	50	72	77	110	82	71.4	
Forbs:										
Epilobium spp.	2	1	1	-	2	-	-	-	0.7	50
Equisetum spp.	-	1	-	-	-	-	-	19	2.5	25
Geocaulon lividum	-	2	-	2	6	6	6	-	2.7	62
Gymnocarpium dryopteris	-	8	-	-	-	-	1	-	1.1	25
Lupinus spp.	-	-	-	-	-	3	-	-	0.4	12
Potentilla spp.	-	-	-	-	-	-	-	2	0.2	12
Sanguisorba spp.	4	-	-	-	-	-	-	2	0.7	25
Total	6	12	1	2	8	9	7	23	5.0	
Grasses:										
Calamagrostis spp.	6	1	-	-	-	-	-	4	1.4	37
Mosses and lichens:										
Alectoria spp.	-	1	-	-	-	-	-	-	0.1	12
Cladina spp.	-	-	23	2	5	-	-	1	3.9	50
Cladonia spp.	-	-	-	-	-	-	1	-	0.1	12
Dicranum spp.	-	-	-	1	1	-	-	-	0.2	25
Hylocomium spp.	7	19	2	27	28	34	17	10	18.0	100
Hypogmnia spp.	1	-	1	1	-	-	-	-	0.4	37
Lycopodium spp.	5	7	-	-	1	13	5	-	3.9	62
Mnium spp.	-	-	-	-	-	-	-	1	0.1	12

See footnotes at end of table.

Table 9a—continued

Species	Plots 22	24	25	27	29	79	133	142	Average cover	Constancy
	- - - - - - -Percent cover[a]- - - - - - -								- - - Percent[b] - -	
Mosses and lichens:										
Other moss species	2	-	-	-	-	-	1	1	0.5	37
Nephroma spp.	-	-	29	3	3	-	-	1	4.5	50
Parmelia spp.	-	-	2	-	-	-	-	-	0.2	12
Peltigera spp.	1	2	4	5	2	3	2	-	2.4	87
Pleurozium schreberi	38	26	30	30	40	31	50	4	31.1	100
Polytrichum spp.	1	1	2	1	3	-	-	-	1.0	62
Ptilium spp.	-	1	-	-	-	-	-	-	0.1	12
Sphagnum spp.	40	30	-	20	-	-	-	70	20.0	50
Total	95	87	93	90	83	81	76	88	86.6	

[a] Tr indicates that the cover of a species within a plot was < 1 percent cover. A dash indicates that the species was absent.

[b] Tr indicates that the average cover of a species was < 0.1 of 1 percent.

Table 9b—Site characteristics of Kenai vegetation plots belonging to the Open *Picea glauca-Picea mariana/Empetrum nigrum-Vaccinium vitis-idaea/Peltigera* spp.-*Pleurozium* spp. community, TWINSPAN subset *0001

Plot	Elevation	Principal cover[a]	Closure[b]	Stand age	Slope position	Slope	Aspect
	Meters			Years		Percent	
22	274.3	Conifer	Open	100	Rolling	13.0	None
24	61.0	Conifer	Open	132	Flat	1.0	NW
25	61.0	Conifer	Open	55	Flat	1.0	NW
27	152.4	Conifer	Open	61	Upper	26.8	NW
29	213.4	Conifer	Open	42	Flat	3.8	NW
79	213.4	Conifer	Open	155	Low	11.8	NW
133	61.0	Mixed	Open	139	Rolling	9.0	None
142	243.8	Conifer	Open	141	Mid	6.2	SW

[a] A stand was classified as conifer if coniferous overstory trees contributed at least 75 percent of tree cover, and similarly for hardwoods. A stand was classified as mixed if neither overstory conifers nor hardwoods contributed at least 75 percent of tree cover.

[b] A stand was classified as closed, open, or woodland if overstory tree cover was at least 60, 25, or 10 percent, respectively. Stands with < 10 percent cover were considered to be nonforest land.

[c] Stand age was calculated as the average of as many as 6 coniferous site trees. Site trees were individuals that had maintained a dominant or codominant canopy position for most of their lives. When possible, site trees were selected from those trees included in the variable-radius plots. If an insufficient number of site trees was obtained from the variable-radius plots, then additional neighboring trees meeting the site tree criterion were selected if possible.

[d] Possible values for slope (topographic) position were flat, low(er slope), mid(slope), upper (slope), and rolling (terrain).

[e] Possible values for aspect are the cardinal compass directions (N, S, E, and W) or combinations (for example, NW, SE).

Table 9c—Soil characteristics of Kenai vegetation plots belonging to the Open *Picea glauca-Picea mariana/Empetrum nigrum-Vaccinium vitis-idaea/Peltigera* spp.-*Pleurozium* spp. community, TWINSPAN subset *0001

Plot	Depth of:[a]						Top mineral horizon		
	Impervious layer[b]	Saturated soil[b]	Root depth	Moss layer	Fibrous organic	Decomposed organic	Texture[c]	Coarse fragments[d]	Depth[a]
	Centimeters								Cm
22	-	-	20	6	11	15	SL	VL	43
24	-	-	17	4	12	16	SL	VL	29
25	-	-	10	3	6	9	SL	VL	28
27	-	-	19	4	13	17	SiL-SL	VL	42
29	-	-	16	4	8	15	L	VL	33
79	-	-	16	3	7	11	L	VL	17
133	-	-	22	3	6	10	SiL-SL	VL	31
142	63	37	20	6	13	22	CL	VL	35

[a] All depths were relative to the top of the moss layer on the soil surface.

[b] A dash indicates that a specific type of soil feature was not observed within the first 50 centimeters below the soil surface.

[c] Soil texture was determined for each of the 5 subplots. Texture classes were CL = clay loam, SiL = silt loam, L = loam, SL = sandy loam, and LS = loamy sand (or sand). For each plot, if the same texture class was recorded on at least 4 of the subplots, then that texture class is reported for the plot, otherwise a range of texture classes is indicated.

[d] The mineral fraction > 2 mm diameter was classed as coarse fragments. Coarse fragment content was recorded as very low (VL < 15 percent), low (15 percent < L < 30 percent), moderate (30 percent < M < 60 percent), or high (H > 60 percent).

Table 10a—Species composition of Kenai vegetation plots included in the Closed *Picea glauca-Betula papyrifera/Cornus canadensis-Vaccinium vitis-idaea/Epilobium* spp./*Pleurozium* spp. community, TWINSPAN subset *001

Species	Plots																								Average cover	Constancy
	21	28	33	35	36	37	39	43	45	48	49	58	64	66	68	69	81	82	115	119	130	132	134	138		
	- Percent cover[a] -																								- - - Percent[b] - -	
Overstory:																										
Betula papyrifera	60	7	10	38	33	49	56	-	86	100	45	65	43	77	100	16	58	2	91	21	66	66	Tr	-	45.4	92
Picea glauca	62	5	33	99	3	48	53	76	3	44	-	-	-	2	73	51	Tr	-	71	39	59	73	61	-	35.6	79
Picea mariana	-	51	-	-	45	51	-	-	-	-	-	9	-	-	-	-	-	-	29	-	9	-	1	-	8.1	29
Picea X lutzii	-	72	13	-	-	13	46	-	26	-	32	14	39	73	Tr	-	64	57	-	24	-	-	-	73	22.8	58
Populus tremuloides	Tr	59	Tr	23	5	-	Tr	4	20	-	9	80	69	10	Tr	11	17	Tr	10	45	71	38	-	-	19.7	83
Populus trichocarpa	-	-	8	-	Tr	-	-	-	-	-	6	-	-	-	-	-	-	-	-	18	-	9	-	6	2.0	25
Total	122	194	64	160	86	161	155	80	135	144	92	168	151	162	174	78	139	59	201	147	205	186	62	79	133.5	
Reproduction:																										
Betula papyrifera	-	-	-	-	4	2	4	-	-	-	-	-	-	-	1	1	2	3	1	-	-	-	-	-	0.7	33
Picea glauca	-	-	1	7	1	13	8	2	3	2	-	-	-	2	-	2	-	-	14	-	-	-	-	-	2.3	46
Picea mariana	-	3	-	-	9	-	-	-	-	-	-	3	-	-	-	-	-	-	1	-	-	-	1	-	0.7	21
Picea X lutzii	-	-	-	-	-	6	-	-	-	-	3	12	-	-	-	-	-	-	-	-	-	-	-	-	0.9	12
Populus tremuloides	-	-	-	3	-	-	-	1	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	0.3	12
Total	0	3	1	10	14	21	12	3	3	2	3	15	0	2	1	3	6	3	16	0	0	0	1	0	4.8	
Shrubs:																										
Alnus spp.	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Tr	4
Betula nana	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	9	2	-	-	-	-	-	-	0.6	12
Cornus canadensis	4	14	3	-	3	2	5	5	6	14	3	11	7	4	6	12	16	8	10	9	11	10	4	26	8.0	96
Cornus suecica	4	-	1	-	1	-	-	4	6	-	-	-	-	3	-	-	1	1	3	-	-	2	1	7	1.4	50
Empetrum nigrum	3	-	-	-	-	-	-	5	-	-	-	-	-	-	3	2	16	5	-	1	-	-	1	-	1.5	33
Ledum groenlandicum	-	-	-	-	1	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	0.9	12
Linnaea borealis	7	15	8	12	7	12	1	10	3	12	7	21	-	-	9	-	4	5	3	3	5	4	4	5	6.5	87
Menziesia ferruginea	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Tr	4
Oplopanax horridum	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1	8
Ribes spp.	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	0.1	8
Rosa acicularis	2	2	-	-	2	-	1	-	3	12	2	3	6	3	9	-	-	-	6	-	3	3	-	3	2.5	62
Rubus spp.	4	-	-	-	-	-	-	10	-	-	1	1	-	-	-	-	5	-	-	-	-	1	1	-	1.0	29
Salix spp.	-	2	-	-	1	-	4	18	-	1	-	-	1	-	7	5	1	1	-	-	-	-	17	1	2.5	50
Shepherdia canadensis	-	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6	4
Sorbus spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	Tr	4
Spiraea spp.	-	-	-	-	-	-	-	-	-	1	-	-	-	-	4	-	-	3	-	-	-	1	-	-	0.4	17
Vaccinium vitis-idaea	33	20	23	22	41	12	41	15	8	10	3	14	26	30	15	8	20	31	51	1	12	15	24	1	19.8	100
other Vaccinium species	-	5	-	-	-	-	-	8	-	-	-	-	1	-	-	1	-	2	-	-	-	2	6	-	1.0	29
Viburnum edule	-	4	3	4	-	7	-	-	10	-	3	1	-	3	-	2	4	-	-	3	4	4	1	3	2.3	62
Total	57	62	52	38	56	34	66	79	37	50	20	52	41	43	53	30	76	58	73	17	41	42	59	48	49.3	
Forbs:																										
Achillea spp.	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	4
Actaea rubra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	Tr	4
Epilobium spp.	1	3	-	-	1	16	1	9	2	5	2	-	3	-	2	5	12	1	1	-	1	1	1	-	2.8	75

Table 10a—continued

Species	Plots																								Average cover	Constancy
	21	28	33	35	36	37	39	43	45	48	49	58	64	66	68	69	81	82	115	119	130	132	134	138		
	- Percent cover[a] -																								- - - Percent[b] - -	
Equisetum spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	Tr	4
Geocaulon lividum	1	2	13	23	1	6	3	2	2	-	-	-	4	19	-	1	4	1	-	8	-	-	1	-	3.8	67
Geranium erianthum	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	4
Gymnocarpium dryoptera	2	19	-	-	5	-	5	-	16	10	17	-	-	-	8	-	11	9	-	-	5	19	21	-	6.1	54
Lupinus spp.	-	-	1	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	0.2	8
Pedicularis labradorica	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	Tr	4
Polemonium spp.	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	4
Pyrola spp.	3	1	1	-	-	-	-	-	-	-	1	1	-	-	-	-	2	1	-	7	1	-	2	-	0.8	42
Sanguisorba spp.	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	4	-	0.6	12
Streptopus spp.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Tr	4
Trientalis europaea	-	-	-	-	2	-	1	2	-	-	2	1	-	-	2	4	-	-	-	-	-	1	-	1	0.7	37
Viola spp.	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Tr	4
Total	7	35	15	23	9	22	10	18	20	16	22	7	7	20	13	10	29	12	1	19	7	21	29	2	15.6	
Grasses:																										
Calamagrostis spp.	-	3	-	-	-	-	1	4	-	-	2	4	1	-	5	-	5	2	-	-	1	-	-	1	1.2	46
Mosses and lichens:																										
Alectoria spp.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	0.1	12
Aulacomnium spp.	-	-	-	-	-	4	1	2	1	-	-	1	-	-	-	-	-	2	-	-	-	-	-	-	0.5	25
Cladina spp.	-	-	-	-	-	3	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	0.2	8
Cladonia spp.	-	-	-	2	1	9	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	0.6	21
Dicranum spp.	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-	0.2	17
Drepanocladus spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	Tr	4
Hylocomium spp.	33	22	27	15	23	1	36	22	5	14	37	21	10	19	1	8	15	31	13	34	22	30	65	55	23.3	100
Hypnum spp.	-	-	-	-	-	-	-	-	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	0.2	12
Hypogmnia spp.	-	-	-	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-	2	-	-	-	-	1	0.2	17
other lichen species	-	-	-	1	-	1	-	-	-	-	-	-	-	2	-	-	1	-	1	1	-	-	-	-	0.3	25
Lycopodium spp.	20	-	1	-	3	-	2	-	10	-	2	7	9	12	1	5	12	1	-	4	15	4	5	-	4.7	71
Mnium spp.	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	0.1	8
other moss species	7	-	-	20	6	10	2	-	-	1	4	1	1	1	-	1	9	5	3	-	-	4	3	1	3.3	71
Nephroma spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	0.1	8
Parmelia spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	0.1	8
Peltigera spp.	1	1	4	14	11	3	4	1	1	1	1	-	1	8	1	1	-	7	1	1	2	1	2	-	2.8	87
Pleurozium schreberi	-	-	10	15	20	25	2	5	16	34	12	26	52	37	41	44	32	12	29	18	29	43	10	2	21.4	92
Polytrichum spp.	-	3	5	-	5	1	3	5	-	2	1	1	1	3	9	3	2	4	15	1	-	3	2	-	2.9	79
Ptilium spp.	1	-	5	-	2	-	-	17	-	2	6	1	-	-	2	1	2	22	-	12	2	3	4	2	3.5	67
Rhytidiadelphus spp.	21	52	12	-	1	-	31	20	-	5	-	2	5	-	3	-	-	-	-	-	1	-	2	17	7.2	25
Sphagnum spp.	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	4	1	-	-	-	-	0.3	25
Total	83	78	65	67	72	57	82	73	38	59	63	62	81	86	58	65	77	84	70	72	74	88	93	78	71.9	

[a] Tr indicates that the cover of a species within a plot was < 1 percent cover. A dash indicates that the species was absent.

[b] Tr indicates that the average cover of a species was < 0.1 of 1 percent.

Table 10b—Site characteristics of Kenai vegetation plots belonging to the Closed *Picea glauca-Betula papyrifera/Vaccinium vitis-idaea/Cornus canadensis/Pleurozium* spp. community, TWINSPAN subset *001

Plot	Elevation	Principal cover[a]	Closure[b]	Stand age	Slope position	Slope	Aspect
	Meters			Years		Percent	
21	152.4	Mixed	Open	137	Low	3.4	NW
28	182.9	Mixed	Open	57	Low	2.0	NW
33	121.9	Conifer	Closed	151	Low	11.6	SW
35	152.4	Mixed	Closed	97	Mid	11.8	NW
36	121.9	Mixed	Open	84	Mid	15.4	SW
37	121.9	Mixed	Open	140	Low	12.4	NW
39	91.4	Mixed	Closed	97	Flat	1.0	NW
43	30.5	Conifer	Open	122	Rolling	1.0	None
45	61.0	Mixed	Closed	126	Mid	5.8	SE
48	61.0	Mixed	Closed	47	Low	3.2	NW
49	91.4	Hardwood	Open	78	Mid	10.0	SW
58	91.4	Hardwood	Open	124	Mid	7.0	SE
64	152.4	Mixed	Closed	65	Flat	1.4	None
66	121.9	Mixed	Closed	113	Mid	9.4	SE
68	61.0	Mixed	Closed	54	Flat	1.0	None
69	30.5	Conifer	Closed	126	Low	10.4	NW
81	91.4	Mixed	Closed	104	Mid	16.0	SW
82	121.9	Mixed	Open	105	Flat	2.8	None
115	91.4	Mixed	Closed	100	Flat	1.0	None
119	121.9	Mixed	Closed	85	Mid	13.4	SW
130	121.9	Mixed	Closed	81	Rolling	3.6	None
132	30.5	Mixed	Closed	84	Flat	1.4	None
134	182.9	Conifer	Open	75	Mid	2.4	NW
138	152.4	Conifer	Closed	47	Low	2.4	SW

[a] A stand was classified as conifer if coniferous overstory trees contributed at least 75 percent of tree cover, and similarly for hardwoods. A stand was classified as mixed if neither overstory conifers nor hardwoods contributed at least 75 percent of tree cover.

[b] A stand was classified as closed, open, or woodland if overstory tree cover was at least 60, 25, or 10 percent, respectively. Stands with < 10 percent cover were considered to be nonforest land.

[c] Stand age was calculated as the average of as many as 6 coniferous site trees. Site trees were individuals that had maintained a dominant or codominant canopy position for most of their lives. When possible, site trees were selected from those trees included in the variable-radius plots. If an insufficient number of site trees was obtained from the variable-radius plots, then additional neighboring trees meeting the site tree criterion were selected if possible.

[d] Possible values for slope (topographic) position were flat, low(er slope), mid(slope), upper (slope), and rolling (terrain).

[e] Possible values for aspect are the cardinal compass directions (N, S, E, and W) or combinations (for example, NW, SE).

Table 10c—Soil characteristics of Kenai vegetation plots belonging to the Closed *Picea glauca-Betula papyrifera/Vaccinium vitis-idaea/Cornus canadensis/Pleurozium* spp. community, TWINSPAN subset *001

Plot	Depth of:[a]						Top mineral horizon		
	Impervious layer[b]	Saturated soil[b]	Root depth	Moss layer	Fibrous organic	Decomposed organic	Texture[c]	Coarse fragments[d]	Depth[a]
	Centimeters								Cm
21	-	-	15	3	8	12	SiL	VL	23
28	-	-	14	1	7	9	SiL	VL	19
33	86	72	22	7	16	27	SiL-L	VL-M	34
35	-	-	21	1	7	9	SiL-L	VL	16
36	-	-	12	2	9	11	SiL	VL	31
37	-	-	18	3	9	12	SL-LS	VL	39
39	-	-	15	4	8	11	SL	VL	19
43	-	-	13	3	8	12	SiL	VL	42
45	-	-	23	4	6	8	SiL-SL	VL	28
48	-	-	17	1	4	7	SL	VL	18
49	-	-	17	1	4	6	SiL	VL	17
58	-	-	15	3	7	11	SL	VL	28
64	-	83	12	1	5	7	SiL-SL	VL	31
66	-	-	20	4	7	10	SL-LS	VL	41
68	-	-	15	1	3	5	SiL	VL	29
69	-	75	30	2	8	12	SiL	VL	29
81	-	-	14	5	10	14	SiL-SL	VL	39
82	-	-	17	3	6	9	SiL-SL	VL	15
115	-	-	17	3	9	13	SiL-SL	VL	39
119	67	-	19	6	13	18	SiL-SL	VL-M	22
130	-	-	13	4	8	12	L	VL	34
132	-	-	19	2	6	10	SL	VL	16
134	-	-	16	3	7	11	SiL-SL	VL	17
138	-	-	16	2	6	10	SiL-SL	VL	30

[a] All depths were relative to the top of the moss layer on the soil surface.

[b] A dash indicates that a specific type of soil feature was not observed within the first 50 centimeters below the soil surface.

[c] Soil texture was determined for each of the 5 subplots. Texture classes were CL = clay loam, SiL = silt loam, L = loam, SL = sandy loam, and LS = loamy sand (or sand). For each plot, if the same texture class was recorded on at least 4 of the subplots, then that texture class is reported for the plot, otherwise a range of texture classes is indicated.

[d] The mineral fraction > 2 mm diameter was classed as coarse fragments. Coarse fragment content was recorded as very low (VL < 15 percent), low (15 percent < L < 30 percent), moderate (30 percent < M < 60 percent), or high (H > 60 percent).

Table 11a—Species composition of Kenai vegetation plots included in the Closed *Picea* × *lutzii-Betula papyrifera/ Menziesia ferruginea-Rubus pedatus/Gymnocarpium dryopteris/Peltigera* spp.-*Pleurozium* spp. vegetation community, TWINSPAN subset *0100

Species	Plots																	Average cover	Constancy
	20	52	57	59	60	83	91	92	96	97	106	120	121	127	136	139	140		
	Percent cover[a]																	Percent[b]	
Overstory:																			
Betula papyrifera	20	75	74	21	44	55	Tr	14	45	25	10	12	33	-	11	-	-	25.9	82
Picea glauca	-	Tr	-	-	-	-	-	-	43	-	Tr	-	6	68	-	4	52	10.2	41
Picea mariana	15	-	-	-	-	-	-	-	-	-	10	-	-	8	-	-	-	1.9	18
Picea X lutzii	54	64	33	33	57	71	100	98	54	92	61	34	46	-	73	19	-	52.3	88
Populus tremuloides	-	-	57	-	-	16	-	-	-	-	-	-	-	-	-	-	-	4.3	12
Populus trichocarpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0.3	6
Tsuga mertensiana	-	-	-	7	16	-	-	-	-	-	-	44	65	-	-	13	51	11.5	35
Total	89	139	164	61	117	142	100	112	142	117	81	90	150	76	84	36	109	106.4	
Reproduction:																			
Betula papyrifera	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	0.1	12
Picea glauca	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	0.3	6
Picea X lutzii	-	-	-	1	-	2	-	1	-	-	-	-	-	-	1	-	-	0.3	23
Tsuga mertensiana	-	-	-	-	16	-	-	-	-	-	-	22	9	-	-	-	20	3.9	23
Total	0	0	0	2	17	2	0	1	0	0	0	22	14	0	1	0	20	4.6	
Shrubs:																			
Alnus spp.	18	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1.2	12
Betula nana	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	0.2	6
Cornus canadensis	1	15	3	1	10	7	5	4	1	4	1	10	2	5	2	9	11	5.3	100
Cornus suecica	-	-	4	1	6	-	-	-	-	-	-	-	10	-	-	-	2	1.3	29
Empetrum nigrum	1	-	-	-	6	2	20	8	6	-	15	1	3	1	-	3	14	4.7	71
Ledum groenlandicum	-	-	-	-	5	-	1	-	-	-	-	-	-	-	-	-	-	0.3	12
Linnaea borealis	2	13	3	7	1	9	2	15	2	3	4	7	6	2	9	3	5	5.5	100
Menziesia ferruginea	-	42	9	59	3	2	26	58	36	-	24	20	6	-	20	23	4	19.5	82
Ribes spp.	1	-	-	1	-	1	-	1	-	-	-	1	1	-	-	-	-	0.3	35
Rosa acicularis	-	1	1	2	-	3	-	-	-	-	-	-	-	7	-	-	-	0.8	29
Rubus pedatus	12	2	3	4	6	3	5	14	17	24	8	9	13	-	11	8	4	8.4	94
Other Rubus spp.	-	-	-	-	-	-	1	-	-	-	-	-	-	6	-	-	-	0.8	18
Salix spp.	-	-	-	-	6	6	-	-	-	-	-	3	-	2	-	-	-	1.0	23
Sorbus spp.	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	0.3	18
Spiraea spp.	5	4	-	-	1	4	1	-	11	-	-	-	-	-	1	5	3	2.1	53
Vaccinium vitis-idaea	0	27	9	28	3	18	6	9	1	-	13	3	-	1	4	-	3	7.3	76
Other Vaccinium spp.	2	-	-	-	-	-	-	1	-	-	-	5	-	-	4	-	-	0.7	23
Viburnum edule	-	2	1	-	1	4	-	-	-	-	-	-	-	-	-	-	-	0.5	23
Total	42	108	33	103	50	59	67	112	77	31	65	59	41	24	51	53	46	60.1	
Forbs:																			
Athyrium filix-femina	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	6
Dryopteris dilatata	-	-	-	-	2	-	-	-	6	10	-	1	1	-	2	-	-	1.3	35
Epilobium spp.	-	3	-	-	1	3	1	1	-	-	-	-	1	1	1	-	-	0.7	47

Table 11a—continued

Species	Plots																	Average cover	Constancy
	20	52	57	59	60	83	91	92	96	97	106	120	121	127	136	139	140		
	Percent cover[a]																	Percent[b]	
Equisetum spp.	20	1	-	-	14	-	22	-	2	-	3	5	-	13	1	-	-	4.8	53
Geocaulon lividum	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	6
Gymnocarpium dryopteris	7	3	25	3	14	11	-	4	28	39	-	-	12	-	9	8	-	9.6	71
Polemonium spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	0.2	6
Potentilla spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	0.1	6
Pyrola spp.	2	-	1	-	-	-	-	1	-	6	3	1	-	-	-	5	-	1.1	41
Sanguisorba spp.	-	-	-	-	-	3	-	-	5	1	-	-	-	-	-	-	-	0.5	18
Streptopus spp.	-	2	-	-	-	1	-	-	-	1	-	-	-	-	1	-	-	0.3	23
Trientalis europaea	-	-	-	-	2	1	-	-	-	-	2	1	2	-	2	-	-	0.6	35
Total	30	15	26	3	33	19	23	6	41	57	8	8	16	19	16	13	-	19.6	
Grasses:																			
Calamagrostis spp.	7	-	3	2	1	2	-	-	4	-	10	1	-	12	1	15	-	3.4	65
Mosses and lichens:																			
Alectoria spp.	3	-	-	-	-	-	3	-	4	1	-	-	-	-	-	2	-	0.8	29
Aulacomnium spp.	-	-	-	1	2	-	-	-	1	2	-	-	2	-	-	-	-	0.5	29
Cladina spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.1	6
Cladonia spp.	1	-	1	1	-	-	-	-	-	1	-	-	1	1	-	-	2	0.5	41
Dicranum spp.	-	1	-	-	4	-	-	-	-	4	-	1	-	-	1	3	8	1.3	41
Hepaticae	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	0.1	12
Hylocomium spp.	17	53	17	36	23	14	1	11	22	19	29	25	2	5	37	16	26	20.8	100
Hypogmnia spp.	1	-	-	-	1	-	1	-	-	-	-	-	-	1	-	-	-	0.2	23
Other lichen species	-	-	-	1	-	-	1	-	-	-	-	-	-	1	-	-	-	0.2	18
Lobaria spp.	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	6
Lycopodium spp.	16	4	3	16	2	5	3	5	-	7	1	2	2	12	1	8	-	5.1	88
Mnium spp.	2	-	-	-	17	-	-	-	-	2	-	5	-	1	1	1	-	1.7	41
Other moss species	1	-	5	-	1	2	5	1	4	-	8	-	-	-	1	1	9	2.3	65
Nephroma spp.	-	-	-	1	-	-	1	-	1	-	-	-	-	-	-	2	-	0.3	23
Parmelia spp.	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	0.1	6
Peltigera spp.	1	1	1	2	8	1	1	4	-	1	2	3	1	4	1	1	2	2.0	94
Pleurozium schreberi	27	-	25	-	6	36	16	1	10	15	15	-	43	30	11	25	19	16.4	82
Polytrichum spp.	3	-	-	2	1	5	-	3	-	4	-	1	2	11	6	2	9	2.9	71
Ptilium spp.	7	3	2	6	5	3	-	-	-	16	-	22	1	2	8	7	-	4.8	71
Rhytidiadelphus spp.	6	14	-	12	10	7	-	49	-	-	12	10	-	4	-	-	-	7.3	53
Sphagnum spp.	1	-	-	-	-	-	60	-	28	6	15	17	15	15	9	4	7	10.4	65
Total	87	76	54	79	80	73	92	74	71	78	82	86	69	87	76	73	84	77.7	

[a] Tr indicates that the cover of a species within a plot was < 1 percent cover. A dash indicates that the species was absent.

[b] Tr indicates that the average cover of a species was < 0.1 of 1 percent.

Table 11b-Site characteristics of Kenai vegetation plots belonging to the Closed *Picea* × *lutzii-Betula papyrifera/Menziesia ferruginosa-Rubus pedatus/Cornus canadensis-Gymnocarpium dryopteris/Peltigera* spp.-*Pleurozium* spp. community, TWINSPAN subset *0100

Plot	Elevation	Principal cover[a]	Closure[b]	Stand age	Slope position	Slope	Aspect
	Meters			Years		Percent	
20	213.4	Conifer	Open	125	Low	5.4	NW
52	61.0	Mixed	Open	164	Low	2.4	SW
57	91.4	Mixed	Closed	112	Rolling	7.6	None
59	152.4	Mixed	Open	152	Mid	16.0	SW
60	182.9	Mixed	Closed	102	Mid	42.0	SE
83	91.4	Mixed	Open	84	Mid	6.2	SW
91	243.8	Conifer	Closed	112	Mid	5.2	NE
92	304.8	Conifer	Open	119	Mid	8.6	SE
96	91.4	Conifer	Closed	131	Low	1.4	NW
97	91.4	Conifer	Closed	118	Flat	4.4	None
106	61.0	Conifer	Closed	150	Mid	9.6	NW
120	152.4	Conifer	Closed	72	Mid	18.8	SW
121	213.4	Mixed	Closed	61	Mid	21.8	SE
127	243.8	Conifer	Closed	107	Flat	1.0	None
136	61.0	Conifer	Closed	150	Flat	1.8	None
139	274.3	Conifer	Closed	110	Mid	4.8	NW
140	426.7	Conifer	Closed	116	Mid	19.2	SW

[a] A stand was classified as conifer if coniferous overstory trees contributed at least 75 percent of tree cover, and similarly for hardwoods. A stand was classified as mixed if neither overstory conifers nor hardwoods contributed at least 75 percent of tree cover.

[b] A stand was classified as closed, open, or woodland if overstory tree cover was at least 60, 25, or 10 percent, respectively. Stands with < 10 percent cover were considered to be nonforest land.

[c] Stand age was calculated as the average of as many as 6 coniferous site trees. Site trees were individuals that had maintained a dominant or codominant canopy position for most of their lives. When possible, site trees were selected from those trees included in the variable-radius plots. If an insufficient number of site trees was obtained from the variable-radius plots, then additional neighboring trees meeting the site tree criterion were selected if possible.

[d] Possible values for slope (topographic) position were flat, low(er slope), mid(slope), upper (slope), and rolling (terrain).

[e] Possible values for aspect are the cardinal compass directions (N, S, E, and W) or combinations (for example, NW, SE).

Table 11c—Soil characteristics of Kenai vegetation plots belonging to the Closed *Picea* × *lutzii-Betula papyrifera/Menziesia ferruginosa-Rubus pedatus/Cornus canadensis-Gymnocarpium dryopteris/Peltigera* spp.-*Pleurozium* spp. community, TWINSPAN subset *0100

Plot	Depth of:[a]						Top mineral horizon		
	Impervious layer[b]	Saturated soil[b]	Root depth	Moss layer	Fibrous organic	Decomposed organic	Texture[c]	Coarse fragments[d]	Depth[a]
	Centimeters								Cm
20	-	-	17	3	11	15	SiL	VL	41
52	-	-	13	2	5	7	L	VL	12
57	-	-	12	2	5	8	SiL	VL	30
59	-	-	21	3	17	22	SL	VL	50
60	-	-	22	4	11	17	L-SL	VL-M	34
83	-	-	14	3	6	8	SiL-SL	VL	32
91	-	-	15	7	14	20	CL-L	VL-M	42
92	-	-	13	2	6	7	SiL-L	VL	19
96	-	-	28	8	11	13	SiL	VL	24
97	-	-	12	3	9	13	SL	VL	35
106	87	-	19	6	13	17	SiL-SL	VL	43
120	-	83	15	4	9	14	CL-L	VL-M	28
121	81	88	17	2	6	11	SL	VL-M	34
127	-	89	21	5	13	18	L	VL	42
136	-	-	15	5	12	15	SiL	VL	27
139	-	-	19	3	7	10	SiL	VL-M	32
140	-	-	18	2	4	7	SiL	VL-L	17

[a] All depths were relative to the top of the moss layer on the soil surface.

[b] A dash indicates that a specific type of soil feature was not observed within the first 50 centimeters below the soil surface.

[c] Soil texture was determined for each of the 5 subplots. Texture classes were CL = clay loam, SiL = silt loam, L = loam, and SL = sandy loam (or sand). For each plot, if the same texture class was recorded on at least 4 of the subplots, then that texture class is reported for the plot, otherwise a range of texture classes is indicated.

[d] The mineral fraction > 2 mm diameter was classed as coarse fragments. Coarse fragment content was recorded as very low (VL < 15 percent), low (15 percent < L < 30 percent), moderate (30 percent < M < 60 percent), or high (H > 60 percent).

Table 12a—Species composition of Kenai vegetation plots included in the Closed *Picea glauca-Betula papyrifera/Menziesia ferruginea-Rubus pedatus/Gymnocarpium dryopteris/Lycopodium* spp.-*Pleurozium* spp. community, TWINSPAN subset *0101

Species	Plots												Average cover	Constancy
	34	44	50	51	53	65	67	80	88	98	100	122		
	Percent cover[a]													Percent[b]
Overstory:														
Betula papyrifera	18	77	91	65	52	60	99	45	38	21	21	26	51.1	100
Picea glauca	23	31	59	46	34	36	23	9	100	-	Tr	-	30.1	83
Picea mariana	-	-	-	-	36	-	-	-	-	-	-	-	3.0	8
Picea X lutzii	-	-	-	-	-	-	6	-	-	97	87	65	21.2	33
Populus tremuloides	-	Tr	-	-	-	-	Tr	-	-	-	-	-	0.1	17
Populus trichocarpa	-	4	-	-	-	-	-	-	-	-	-	25	2.4	17
Total	41	112	150	111	122	96	128	54	138	118	108	116	107.8	
Reproduction:														
Betula papyrifera	-	-	-	2	-	-	-	-	1	-	-	-	0.2	17
Picea glauca	-	2	1	5	1	-	-	-	3	-	-	-	1.0	42
Total	0	2	1	7	1	0	0	0	4	0	0	0	1.2	
Shrubs:														
Alnus spp.	21	-	-	-	10	30	-	13	1	-	-	10	7.1	50
Cornus canadensis	1	8	13	10	10	5	7	7	5	-	2	2	5.8	92
Cornus stolonifera	-	-	-	-	-	-	-	-	-	-	-	2	0.2	17
Cornus suecica	-	-	-	12	6	-	6	9	-	-	-	-	2.7	33
Linnaea borealis	3	5	7	6	1	2	7	13	12	2	6	-	5.3	92
Menziesia ferruginea	35	2	29	39	3	3	8	52	24	40	18	-	21.1	92
Oplopanax horridum	8	-	-	2	2	12	-	-	-	-	-	-	2.0	33
Ribes spp.	-	-	-	1	-	-	-	-	-	-	-	2	0.2	17
Rosa acicularis	1	4	2	8	2	-	4	-	-	-	-	3	2.0	58
Rubus pedatus	2	11	-	6	2	3	5	26	12	25	14	0	8.8	83
Other Rubus spp.	-	-	-	-	-	2	-	-	-	-	-	2	0.3	17
Salix spp.	-	1	-	-	-	-	-	-	-	-	-	-	0.1	8
Sambucus racemosa	-	-	-	-	2	7	3	-	-	-	-	-	1.0	25
Sorbus spp.	-	-	-	-	-	2	-	-	-	-	-	-	0.2	8
Spiraea spp.	-	2	-	-	-	-	-	-	1	-	-	-	0.2	17
Vaccinium spp.	-	4	5	10	-	-	4	3	14	1	-	-	3.4	58
Viburnum edule	3	-	4	17	1	4	2	-	3	2	-	8	3.7	75
Total	74	37	60	111	39	70	46	123	72	70	40	29	64.2	
Forbs:														
Athyrium filix-femina	-	-	-	-	-	-	-	-	-	-	-	1	0.1	8
Dryopteris dilatata	4	-	-	2	-	8	3	4	2	25	18	-	5.5	67
Epilobium spp.	-	1	-	1	-	7	1	-	2	-	2	2	1.3	57
Equisetum spp.	-	-	-	2	18	-	-	-	-	-	-	25	3.7	17
Galium spp.	-	-	-	-	-	1	-	-	-	-	-	-	0.1	8
Geocaulon lividum	1	-	-	2	-	-	-	-	-	-	-	-	0.2	17
Geranium erianthum	-	-	-	-	-	-	-	-	1	-	-	-	0.1	8

Table 12a—continued

Species	Plots												Average cover	Constancy
	34	44	50	51	53	65	67	80	88	98	100	122		
	Percent cover[a]													Percent[b]
Gymnocarpium dryopteris	2	27	8	12	4	15	1	30	23	36	14	10	15.2	100
Polystichum braunii	-	-	-	-	-	-	-	-	-	-	-	3	0.2	8
Pyrola spp.	-	-	2	5	2	-	7	1	2	14	2	2	3.1	75
Sanguisorba spp.	-	2	-	-	2	-	-	-	4	-	1	-	0.7	33
Streptopus spp.	-	-	-	1	2	-	-	-	1	1	1	2	0.7	50
Trientalis europaea	1	1	-	-	1	8	3	-	-	4	1	1	1.7	67
Total	8	31	10	25	29	39	15	35	35	80	39	46	32.7	
Grasses:														
Calamagrostis spp.	3	-	-	-	36	6	1	8	1	-	1	1	4.7	67
Mosses and lichens:														
Alectoria spp.	-	3	-	-	-	-	-	-	1	-	-	-	0.3	17
Aulacomnium spp.	-	1	4	-	-	-	3	-	2	1	-	-	0.9	42
Cladonia spp.	-	-	1	-	-	-	-	-	1	-	-	1	0.2	25
Dicranum spp.	-	-	2	-	-	-	2	-	1	1	2	1	0.7	50
Drepanocladus spp.	-	-	-	4	-	-	-	-	-	-	-	-	0.3	8
Hepaticae	-	-	1	-	-	-	-	-	-	-	-	-	0.1	8
Hylocomium spp.	31	9	5	35	10	1	1	8	23	8	30	5	13.8	100
Hypnum spp.	-	-	-	1	1	-	-	-	-	-	-	-	0.2	17
Hypogmnia spp.	1	-	1	1	-	-	-	-	1	1	-	1	0.5	50
Other lichen species	-	-	-	1	-	-	-	-	-	1	-	-	0.2	17
Lobaria spp.	-	-	-	-	-	-	1	-	-	-	-	-	0.1	8
Lycopodium spp.	10	39	12	15	1	1	2	26	14	16	14	-	12.5	92
Mnium spp.	-	-	-	-	8	1	-	-	3	5	-	4	1.7	42
Other moss species	1	1	-	3	7	7	2	-	1	6	2	3	2.7	83
Nephroma spp.	1	1	1	-	-	-	-	-	1	-	-	-	0.3	33
Parmelia spp.	-	-	-	-	-	-	-	-	-	1	-	-	0.1	8
Peltigera spp.	-	-	-	-	-	-	-	-	4	-	-	-	0.3	8
Pleurozium schreberi	14	24	23	17	5	-	5	17	18	5	20	10	13.2	92
Polytrichum spp.	-	-	-	-	-	-	1	3	3	-	7	-	1.2	33
Ptilium spp.	-	4	2	1	2	-	-	-	-	6	27	12	4.5	58
Rhytidiadelphus spp.	2	1	5	-	-	-	-	-	5	-	-	9	1.8	42
Sphagnum spp.	1	-	-	-	-	-	-	-	-	-	-	-	0.1	8
Usnea spp.	-	1	-	-	-	-	-	-	-	-	-	-	0.1	8
Total	61	84	57	78	34	10	17	54	78	51	102	46	56.0	

[a] Tr indicates that the cover of a species within a plot was < 1 percent cover. A dash indicates that the species was absent.

[b] Tr indicates that the average cover of a species was < 0.1 of 1 percent.

Table 12b—Site characteristics of Kenai vegetation plots belonging to the Closed *Picea glauca-Betula papyrifera/Menziesia ferruginea-Rubus pedatus/Gymnocarpium dryopteris/Lycopodium* spp.-*Pleurozium* spp. community, TWINSPAN subset *0101

Plot	Elevation	Principal cover[a]	Closure[b]	Stand age	Slope position	Slope	Aspect
	Meters			Years		Percent	
34	243.8	Conifer	Closed	119	Mid	48.8	SE
44	30.5	Mixed	Closed	100	Rolling	1.0	None
50	61.0	Hardwood	Closed	81	Rolling	3.4	None
51	61.0	Mixed	Open	138	Low	3.2	SW
53	61.0	Mixed	Open	104	Flat	1.0	None
65	121.9	Mixed	Open	118	Mid	14.6	SW
67	121.9	Hardwood	Closed	60	Mid	12.4	SE
80	182.9	Mixed	Open	NA	Mid	25.0	SW
88	152.4	Mixed	Closed	87	Mid	14.4	NW
98	91.4	Conifer	Closed	112	Low	6.0	NW
100	61.0	Conifer	Closed	125	Low	13.0	SW
122	152.4	Mixed	Closed	92	Flat	1.0	None

[a] A stand was classified as conifer if coniferous overstory trees contributed at least 75 percent of tree cover, and similarly for hardwoods. A stand was classified as mixed if neither overstory conifers nor hardwoods contributed at least 75 percent of tree cover.

[b] A stand was classified as closed, open, or woodland if overstory tree cover was at least 60, 25, or 10 percent, respectively. Stands with < 10 percent cover were considered to be nonforest land.

[c] Stand age was calculated as the average of as many as 6 coniferous site trees. Site trees were individuals that had maintained a dominant or codominant canopy position for most of their lives. When possible, site trees were selected from those trees included in the variable-radius plots. If an insufficient number of site trees was obtained from the variable-radius plots, then additional neighboring trees meeting the site tree criterion were selected if possible.

[d] Possible values for slope (topographic) position were flat, low(er slope), mid(slope), upper (slope), and rolling (terrain).

[e] Possible values for aspect are the cardinal compass directions (N, S, E, and W) or combinations (for example, NW, SE).

Table 12c—Soil characteristics of Kenai vegetation plots belonging to the Closed *Picea glauca-Betula papyrifera/Menziesia ferruginea-Rubus pedatus/Gymnocarpium dryopteris/Lycopodium* spp.-*Pleurozium* spp. community, TWINSPAN subset *0101

Plot	Depth of:[a]						Top mineral horizon		
	Impervious layer[b]	Saturated soil[b]	Root depth	Moss layer	Fibrous organic	Decomposed organic	Texture[c]	Coarse fragments[d]	Depth[a]
	Centimeters								Cm
34	52	-	22	4	10	15	SL	VL-H	38
44	-	-	12	2	7	13	CL-SL	VL	31
50	-	-	12	3	6	9	SL	VL	41
51	-	-	17	2	7	10	SL	VL	37
53	-	31	13	4	15	20	CL-L	VL-L	31
65	-	-	20	1	7	11	SL-LS	VL	33
67	-	-	24	1	6	9	SL	VL	40
80	-	-	18	3	11	15	SL	VL	27
88	-	-	17	3	8	12	SiL-SL	VL	40
98	-	89	15	4	13	14	SL	VL	43
100	-	-	14	2	4	9	SL	VL	36
122	-	-	21	3	5	8	SiL-LS	VL	15

[a] All depths were relative to the top of the moss layer on the soil surface.

[b] A dash indicates that a specific type of soil feature was not observed within the first 50 centimeters below the soil surface.

[c] Soil texture was determined for each of the 5 subplots. Texture classes were CL = clay loam, SiL = silt loam, L = loam, SL = sandy loam, and LS = loamy sand (or sand). For each plot, if the same texture class was recorded on at least 4 of the subplots, then that texture class is reported for the plot, otherwise a range of texture classes is indicated.

[d] The mineral fraction > 2 mm diameter was classed as coarse fragments. Coarse fragment content was recorded as very low (VL < 15 percent), low (15 percent < L < 30 percent), moderate (30 percent < M < 60 percent), or high (H > 60 percent).

Table 13a—Species composition of Kenai vegetation plots included in the Closed *Picea glauca-Picea* × *lutzii/Linnea borealis-Rubus pedatus/Sanguisorba* spp.-*Calamagrostis* spp./*Lycopodium* spp.-*Ptilium* spp. community, TWINSPAN subset *0110

Species	Plots									Average cover	Constancy
	18	19	26	70	84	85	87	94	102		
	Percent cover[a]									Percent[b]	
Overstory:											
Betula papyrifera	80	11	Tr	8	3	14	89	10	21	26.2	100
Picea glauca	-	-	100	55	59	96	-	-	-	34.4	44
Picea sitchensis	-	-	-	-	-	-	-	74	-	8.2	11
Picea X lutzii	51	98	Tr	-	36	-	37	-	95	35.3	67
Populus tremuloides	-	-	36	5	-	-	-	-	-	4.5	22
Total	131	109	137	68	98	110	126	84	116	108.8	
Reproduction:											
Betula papyrifera	-	-	-	11	3	-	-	-	1	1.7	33
Picea glauca	-	-	-	4	-	-	-	-	-	0.4	11
Picea X lutzii	-	1	-	-	5	-	1	-	1	0.9	44
Total	0	1	0	15	8	0	1	0	2	3.0	
Shrubs:											
Betula nana	-	-	-	1	6	-	-	-	-	0.8	22
Cornus canadensis	3	6	2	8	8	-	4	-	4	3.9	78
Cornus suecica	-	-	3	2	-	-	2	-	-	0.8	33
Empetrum nigrum	-	-	1	3	14	-	-	-	-	2.0	33
Linnaea borealis	6	15	9	10	6	5	4	1	16	8.0	100
Menziesia ferruginea	-	-	6	-	-	-	-	-	-	0.7	11
Ribes spp.	-	4	-	4	-	1	-	1	2	1.3	55
Rubus pedatus	26	17	6	10	8	30	16	4	28	16.1	100
Other Rubus spp.	-	-	1	-	5	-	-	3	1	1.1	44
Salix spp.	-	-	2	8	28	-	-	-	-	4.2	33
Sambucus racemosa	-	-	1	-	-	-	-	-	-	0.1	11
Spiraea spp.	1	1	1	9	10	-	-	-	3	2.8	67
Vaccinium spp.	-	5	5	8	14	-	-	-	3	3.9	55
Viburnum edule	-	-	-	-	-	6	2	-	-	0.9	22
Total	36	48	37	63	99	42	28	9	57	46.6	
Forbs:											
Achillea spp.	-	-	1	-	-	-	-	-	-	0.1	11
Athyrium filix-femina	-	2	-	-	-	-	-	-	-	0.2	11
Dryopteris dilatata	1	8	-	-	-	13	9	17	7	6.1	67
Epilobium spp.	3	5	1	4	4	1	2	2	4	2.9	100
Equisetum spp.	1	1	-	1	-	1	6	3	2	1.7	78
Geocaulon lividum	-	1	-	-	-	-	-	-	-	0.1	11
Geranium erianthum	1	2	1	-	-	1	-	1	4	1.1	67
Gymnocarpium dryopteris	49	12	6	3	12	26	18	19	10	17.2	100
Lupinus spp.	-	-	-	-	-	-	-	1	-	0.1	11
Pyrola spp.	2	-	1	-	1	3	7	-	2	1.7	67
Sanguisorba spp.	3	2	11	3	2	4	6	19	15	7.2	100
Streptopus spp.	-	2	-	-	-	4	5	1	4	1.8	55
Trientalis europaea	1	-	1	-	-	1	-	-	-	0.3	33
Total	61	35	22	11	21	54	51	63	48	40.7	
Grasses:											
Calamagrostis spp.	7	3	10	37	3	7	11	8	1	9.7	100
Mosses and lichens:											
Alectoria spp.	-	1	-	2	-	1	1	-	-	0.5	44
Aulacomnium spp.	2	-	1	-	-	-	1	1	-	0.5	44
Cladonia spp.	-	1	-	-	-	-	1	-	1	0.3	11

See footnotes at end of table.

Table 13a—continued

Species	Plots									Average cover	Constancy
	18	19	26	70	84	85	87	94	102		
	Percent cover[a]									Percent[b]	
Mosses and lichens:											
Dicranum spp.	-	1	-	-	2	1	2	2	1	1.0	67
Hepaticae	-	-	-	-	-	-	1	1	-	0.2	22
Hylocomium spp.	10	40	30	8	7	21	4	20	22	18.0	100
Hypnum spp.	-	-	-	-	-	-	3	5	-	0.9	22
Hypogmnia spp.	-	-	1	3	-	1	-	1	-	0.7	44
Other lichen species	-	-	-	-	-	1	-	-	-	0.1	11
Lobaria spp.	1	-	-	-	-	-	-	-	-	0.1	11
Lycopodium spp.	26	18	2	25	1	8	23	-	4	11.9	89
Mnium spp.	-	1	3	4	-	9	1	9	2	3.2	78
Other moss species	2	-	2	-	-	2	-	-	-	0.7	33
Nephroma spp.	-	-	2	-	1	1	-	-	-	0.4	33
Peltigera spp.	-	1	-	-	1	1	-	1	1	0.5	55
Pleurozium schreberi	10	-	22	15	39	8	7	37	-	15.3	78
Polytrichum spp.	5	1	10	4	25	-	-	-	1	5.1	67
Ptilium spp.	1	8	3	22	6	8	4	1	4	6.3	100
Rhytidiadelphus spp.	-	6	12	-	-	4	4	6	29	6.8	67
Sphagnum spp.	-	-	-	-	-	-	-	-	11	1.2	11
Total	57	78	88	83	82	66	52	84	76	74.0	

[a] Tr indicates that the cover of a species within a plot was < 1 percent cover. A dash indicates that the species was absent.

[b] Tr indicates that the average cover of a species was < 0.1 of 1 percent.

Table 13b—Site characteristics of Kenai vegetation plots belonging to the Closed *Picea glauca-Picea* × *lutzii/Linnea borealis-Rubus pedatus/ Sanguisorba* spp.-*Calamagrostis* spp./*Lycopodium* spp.-*Ptilium* spp. community, TWINSPAN subset *0110

Plot	Elevation	Principal cover[a]	Closure[b]	Stand age	Slope position	Slope	Aspect
	Meters			Years		Percent	
18	91.4	Mixed	Closed	86	Flat	1.2	None
19	243.8	Mixed	Open	93	Low	3.2	NW
26	152.4	Mixed	Closed	63	Mid	16.0	SW
70	30.5	Conifer	Open	93	Flat	1.0	None
84	61.0	Conifer	Open	112	Low	4.0	NW
85	121.9	Mixed	Open	107	Mid	4.4	SE
87	121.9	Mixed	Open	137	Mid	7.0	NW
94	243.8	Conifer	Open	84	Mid	37.2	SE
102	274.3	Conifer	Open	116	Flat	1.4	None

[a] A stand was classified as conifer if coniferous overstory trees contributed at least 75 percent of tree cover, and similarly for hardwoods. A stand was classified as mixed if neither overstory conifers nor hardwoods contributed at least 75 percent of tree cover.

[b] A stand was classified as closed, open, or woodland if overstory tree cover was at least 60, 25, or 10 percent, respectively. Stands with < 10 percent cover were considered to be nonforest land.

[c] Stand age was calculated as the average of as many as 6 coniferous site trees. Site trees were individuals that had maintained a dominant or codominant canopy position for most of their lives. When possible, site trees were selected from those trees included in the variable-radius plots. If an insufficient number of site trees was obtained from the variable-radius plots, then additional neighboring trees meeting the site tree criterion were selected if possible.

[d] Possible values for slope (topographic) position were flat, low(er slope), mid(slope), upper (slope), and rolling (terrain).

[e] Possible values for aspect are the cardinal compass directions (N, S, E, and W) or combinations (for example, NW, SE).

Table 13c—Soil characteristics of Kenai vegetation plots belonging to the Closed *Picea glauca-Picea* × *lutzii/Linnea borealis-Rubus pedatus/Sanguisorba* spp.-*Calamagrostis* spp./*Lycopodium* spp.-*Ptilium* spp. community, TWINSPAN subset *0110

Plot	Depth of:[a]						Top mineral horizon		
	Impervious layer[b]	Saturated soil[b]	Root depth	Moss layer	Fibrous organic	Decomposed organic	Texture[c]	Coarse fragments[d]	Depth[a]
	- - - - - - - - - - - - - - - Centimeters - - - - - - - - - - -								Cm
18	-	-	11	1	5	7	SiL-SL	VL	19
19	-	-	15	3	6	9	SiL	VL	16
26	-	-	22	3	8	11	SL	VL	43
70	-	-	14	4	12	13	SiL-SL	VL	40
84	-	-	18	4	12	10	SiL-SL	VL	39
85	-	-	17	2	5	10	SL	VL	41
87	-	-	12	2	6	10	SiL-L	VL	40
94	-	-	16	1	5	8	CL-SL	VL	35
102	-	-	9	2	5	8	CL	VL	34

[a] All depths were relative to the top of the moss layer on the soil surface.

[b] A dash indicates that a specific type of soil feature was not observed within the first 50 centimeters below the soil surface.

[c] Soil texture was determined for each of the 5 subplots. Texture classes were CL = clay loam, SiL = silt loam, L = loam, SL = sandy loam, and LS = loamy sand (or sand). For each plot, if the same texture class was recorded on at least 4 of the subplots, then that texture class is reported for the plot, otherwise a range of texture classes is indicated.

[d] The mineral fraction > 2 mm diameter was classed as coarse fragments. Coarse fragment content was recorded as very low (VL < 15 percent), low (15 percent < L < 30 percent), moderate (30 percent < M < 60 percent), or high (H > 60 percent).

Table 14a—Species composition of Kenai vegetation plots included in the Closed *Picea* × *lutzii*/*Rubus pedatus-Salix* spp./*Sanguisorba* spp.-*Calamagrostis* spp./*Mnium* spp. community, TWINSPAN subset *0111

Species	Plots												Average cover	Constancy
	86	89	90	95	101	103	104	105	108	109	126	137		
	Percent cover[a]												Percent[b]	
Overstory:														
Betula papyrifera	18	7	-	15	-	-	-	-	13	-	-	1	4.5	48
Picea glauca	-	87	100	-	-	-	Tr	-	-	-	100	-	24.0	33
Picea X lutzii	85	-	-	97	100	93	100	100	83	95	-	46	66.6	75
Tsuga mertensiana	-	-	-	-	-	-	-	-	-	-	-	Tr	Tr	8
Total	103	94	100	112	100	93	100	100	96	95	100	47	95.5	
Reproduction:														
Betula papyrifera	1	-	-	-	-	-	-	-	-	-	-	1	2.2	17
Picea glauca	-	1	-	-	-	-	-	-	-	-	2	-	0.2	17
Picea X lutzii	6	-	-	1	8	1	-	-	12	2	-	1	2.6	58
Total	7	1	0	1	8	1	0	0	12	2	2	1	3.0	
Shrubs:														
Alnus spp.	-	-	-	-	-	-	-	-	-	1	-	26	2.2	17
Betula nana	-	-	-	-	-	-	-	2	-	-	-	1	0.2	17
Cornus canadensis	4	4	-	4	7	-	-	-	-	3	5	7	2.8	58
Cornus suecica	-	-	-	1	2	-	-	6	-	-	12	-	1.7	33
Empetrum nigrum	5	1	-	6	4	-	-	2	1	-	3	8	2.5	67
Ledum groenlandicum	-	-	-	-	-	-	-	-	-	-	-	2	0.2	8
Linnaea borealis	10	6	-	-	5	1	-	4	10	4	7	7	4.5	75
Menziesia ferruginea	-	-	-	10	-	-	-	-	-	9	4	7	3.3	33
Oplopanax horridum	-	-	-	-	-	-	-	-	-	1	-	-	0.1	8
Ribes spp.	1	-	-	1	1	1	3	-	1	-	-	-	0.7	50
Rosa acicularis	-	-	-	-	-	-	-	-	-	-	-	1	0.1	8
Rubus pedatus	17	6	9	28	20	28	24	2	8	7	13	12	14.5	100
Other Rubus spp.	4	5	-	-	2	2	7	5	2	1	5	1	2.4	83
Salix spp.	2	3	3	1	3	8	8	26	6	-	5	7	6.0	92
Sorbus spp.	-	-	-	-	-	-	-	-	-	1	-	1	0.2	17
Spiraea spp.	3	1	1	6	-	2	-	-	-	7	4	8	3.5	67
Vaccinium vitis-idaea	14	-	-	8	-	-	-	4	1	9	3	5	3.7	50
Other Vaccinium spp.	2	-	4	1	3	5	1	3	2	-	3	2	2.2	83
Viburnum edule	-	-	-	-	-	-	-	-	1	-	-	-	0.1	8
Total	62	26	17	66	47	47	43	54	32	43	64	95	49.7	
Forbs:														
Aconitum delphinifolium	-	-	2	-	-	-	-	-	2	-	-	-	0.3	17
Actaea rubra	-	-	-	-	-	-	-	-	2	-	-	-	0.2	8
Anemone spp.	-	-	-	-	-	-	-	-	7	-	-	-	0.6	8
Aquilegia spp.	-	-	-	-	-	-	-	-	2	-	-	-	0.2	8
Athyrium filix-femina	-	-	-	-	-	-	7	-	-	-	-	-	0.6	8
Castilleja unalaschcensis	-	-	-	-	-	-	-	-	-	-	1	-	0.1	8
Circaea alpina	-	-	-	-	-	-	-	-	3	-	-	-	0.2	8

Table 14a—continued

Species	Plots 86	89	90	95	101	103	104	105	108	109	126	137	Average cover	Constancy
	Percent cover[a]												Percent[b]	
Dryopteris dilatata	1	-	-	4	-	-	16	-	1	8	3	-	2.7	50
Epilobium spp.	7	-	-	-	3	2	4	2	1	2	1	2	1.9	75
Equisetum spp.	4	7	3	5	16	1	2	42	27	6	-	3	9.7	92
Gentiana amarella	1	-	-	-	-	-	-	-	-	-	-	-	0.1	8
Geranium erianthum	1	2	4	-	1	3	1	-	2	-	3	1	1.5	75
Gymnocarpium dryopteris	11	2	11	27	23	11	-	6	4	2	16	3	9.7	92
Listera cordata	-	-	-	6	-	-	-	-	-	-	-	-	0.5	8
Lupinus spp.	-	4	8	-	-	6	9	-	-	-	1	-	2.3	42
Moneses uniflora	-	-	-	-	-	-	2	-	-	-	-	-	0.2	8
Pyrola spp.	6	5	2	-	8	2	9	2	6	-	-	1	3.4	75
Sanguisorba spp.	7	4	5	1	6	13	-	5	14	-	3	6	5.3	83
Streptopus spp.	-	2	-	1	7	4	8	1	3	3	4	-	2.7	75
Stellaria sitchana	-	-	-	-	-	-	-	-	-	1	-	-	0.1	8
Trientalis europaea	2	-	1	6	1	2	3	1	4	1	4	-	2.1	83
Veratrum viride	-	-	16	-	5	20	3	-	-	3	10	-	4.7	50
Total	40	26	52	50	70	64	64	59	78	26	46	16	49.2	
Grasses:														
Calamagrostis spp.	10	4	3	2	10	4	5	3	15	-	4	7	5.6	92
Carex spp.	-	-	2	-	-	-	-	-	-	-	-	-	0.2	8
Mosses and lichens:														
Alectoria spp.	2	-	2	-	-	-	-	2	-	-	-	-	0.5	25
Aulacomnium spp.	-	-	6	5	7	-	3	7	-	-	-	-	2.3	42
Cladina spp.	1	-	-	-	1	-	-	-	-	-	-	-	0.2	17
Cladonia spp.	-	-	1	-	-	-	1	-	-	-	-	-	0.2	17
Dicranum spp.	2	1	-	2	-	-	-	-	8	2	5	-	1.7	50
Hepaticae	-	-	2	-	-	-	-	-	-	-	-	-	0.2	8
Hylocomium spp.	7	43	17	29	22	5	-	17	21	8	15	5	15.7	92
Hypnum spp.	-	-	-	-	-	-	2	-	-	-	-	-	0.2	8
Hypogmnia spp.	1	-	1	-	-	-	1	1	-	1	-	-	0.4	42
Other lichen species	-	-	-	1	1	-	-	-	-	-	2	-	0.3	25
Lycopodium spp.	11	2	20	10	-	4	-	1	-	8	20	3	6.6	75
Mnium spp.	2	2	2	9	10	17	9	11	28	5	3	2	8.3	100
Other moss species	2	5	-	1	6	3	9	5	16	1	11	1	5.0	92
Nephroma spp.	1	1	-	3	4	-	-	1	-	-	-	-	0.8	42
Peltigera spp.	1	-	1	2	5	-	1	1	1	1	1	1	1.2	83
Pleurozium schreberi	42	12	20	5	25	-	40	-	16	20	3	22	17.1	83
Polytrichum spp.	22	-	3	15	12	5	5	-	-	27	11	3	8.6	75
Ptilium spp.	2	-	-	3	-	-	-	-	2	-	-	-	0.6	25
Rhytidiadelphus spp.	-	-	18	-	-	58	-	10	-	-	11	-	8.1	33
Sphagnum spp.	2	20	-	16	6	-	-	32	-	1	-	41	9.8	58
Total	98	86	93	101	99	92	71	88	92	74	82	78	87.8	

[a] Tr indicates that the cover of a species within a plot was < 1 percent cover. A dash indicates that the species was absent.

[b] Tr indicates that the average cover of a species was < 0.1 of 1 percent.

Table 14b—Site characteristics of Kenai vegetation plots belonging to the Closed *Picea* × *lutzii/Rubus pedatus-Salix* spp./*Sanguisorba* spp.-*Calamagrostis* spp./*Mnium* spp. community, TWINSPAN subset *0111

Plot	Elevation	Principal cover[a]	Closure[b]	Stand age	Slope position	Slope	Aspect
	Meters			Years		Percent	
86	152.4	Conifer	Open	108	Flat	4.8	None
89	365.8	Conifer	Closed	144	Mid	39.6	SW
90	457.2	Conifer	Open	99	Flat	1.0	None
95	182.9	Conifer	Closed	107	Mid	32.0	NW
101	365.8	Conifer	Open	108	Flat	4.8	None
103	487.7	Conifer	Open	114	Mid	6.0	NE
104	457.2	Conifer	Closed	94	Mid	6.2	SW
105	396.2	Conifer	Closed	119	Mid	4.6	SW
108	213.4	Mixed	Closed	90	Mid	8.2	SW
109	304.8	Conifer	Closed	118	Flat	2.8	None
126	457.2	Conifer	Open	87	Mid	15.0	NW
137	335.3	Conifer	Open	120	Mid	8.6	SW

[a] A stand was classified as conifer if coniferous overstory trees contributed at least 75 percent of tree cover, and similarly for hardwoods. A stand was classified as mixed if neither overstory conifers nor hardwoods contributed at least 75 percent of tree cover.

[b] A stand was classified as closed, open, or woodland if overstory tree cover was at least 60, 25, or 10 percent, respectively. Stands with < 10 percent cover were considered to be nonforest land.

[c] Stand age was calculated as the average of as many as 6 coniferous site trees. Site trees were individuals that had maintained a dominant or codominant canopy position for most of their lives. When possible, site trees were selected from those trees included in the variable-radius plots. If an insufficient number of site trees was obtained from the variable-radius plots, then additional neighboring trees meeting the site tree criterion were selected if possible.

[d] Possible values for slope (topographic) position were flat, low(er slope), mid(slope), upper (slope), and rolling (terrain).

[e] Possible values for aspect are the cardinal compass directions (N, S, E, and W) or combinations (for example, NW, SE).

Table 14c—Soil characteristics of Kenai vegetation plots belonging to the Closed *Picea* × *lutzii/Rubus pedatus-Salix* spp./*Sanguisorba* spp.-*Calamagrostis* spp./ *Mnium* spp. community, TWINSPAN subset *0111

Plot	Depth of:[a]						Top mineral horizon		
	Impervious layer[b]	Saturated soil[b]	Root depth	Moss layer	Fibrous organic	Decomposed organic	Texture[c]	Coarse fragments[d]	Depth[a]
	Centimeters								Cm
86	-	-	19	6	9	12	SiL-SL	VL	22
89	-	-	18	5	7	11	SiL-SL	VL	38
90	-	-	11	3	6	10	SiL	VL	45
95	-	-	25	7	12	18	SiL	VL	28
101	-	-	14	3	5	9	CL-SiL	VL	19
103	-	-	16	2	4	5	SiL-L	VL	25
104	-	-	12	4	6	10	SiL-SL	VL	42
105	55	49	15	2	5	8	SiL-L	VL	25
108	-	-	17	2	6	11	CL-SL	VL-M	37
109	-	-	18	3	5	7	SiL	VL	14
126	-	-	17	2	5	8	SiL-SL	VL	21
137	81	86	15	1	7	9	SiL	VL	24

[a] All depths were relative to the top of the moss layer on the soil surface.

[b] A dash indicates that a specific type of soil feature was not observed within the first 50 centimeters below the soil surface.

[c] Soil texture was determined for each of the 5 subplots. Texture classes were CL = clay loam, SiL = silt loam, L = loam, and SL = sandy loam (or sand). For each plot, if the same texture class was recorded on at least 4 of the subplots, then that texture class is reported for the plot, otherwise a range of texture classes is indicated.

[d] The mineral fraction > 2 mm diameter was classed as coarse fragments. Coarse fragment content was recorded as very low (VL < 15 percent), low (15 percent < L < 30 percent), moderate (30 percent < M < 60 percent), or high (H > 60 percent).

Table 15a—Species composition of Kenai vegetation plots included in the Closed *Picea* × *lutzii-Tsuga mertensiana/Cornus canadensis-Menziesia ferruginea/Sphagnum* spp. community, TWINSPAN subset *1000

Species	Plots															Average cover	Constancy
	1	32	55	62	63	71	72	74	75	78	113	118	123	141	143		
	Percent cover[a]															Percent[b]	
Overstory:																	
Betula papyrifera	-	43	-	-	-	Tr	1	-	-	-	11	-	-	-	100	10.4	33
Picea glauca	-	-	-	-	-	12	-	-	-	-	-	9	-	-	-	1.4	13
Picea mariana	-	-	-	-	-	-	-	-	-	-	-	-	Tr	-	-	Tr	7
Picea sitchensis	30	-	21	-	-	-	-	-	-	-	-	-	-	-	-	3.4	13
Picea X lutzii	-	15	-	70	21	8	52	85	18	24	85	6	34	44	81	36.2	87
Tsuga mertensiana	43	56	95	61	88	89	49	46	50	82	72	100	88	65	43	68.5	100
Total	73	114	116	131	109	110	102	131	68	106	168	115	122	109	224	119.9	
Reproduction:																	
Betula papyrifera	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	0.1	7
Picea glauca	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	0.1	7
Picea sitchensis	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	7
Picea X lutzii	-	11	-	-	-	2	3	-	-	-	-	-	-	-	-	1.1	20
Tsuga mertensiana	7	-	13	14	3	16	12	12	2	12	12	22	7	3	22	10.5	93
Total	10	11	13	14	3	18	16	12	2	12	12	23	7	3	221	1.9	
Shrubs:																	
Alnus spp.	-	-	4	8	9	-	-	-	-	-	6	-	-	-	-	1.8	27
Cornus canadensis	3	-	3	10	7	2	2	5	1	7	3	4	2	2	2	3.5	93
Cornus suecica	-	-	-	8	-	-	-	-	-	3	1	-	-	-	-	0.8	20
Empetrum nigrum	2	-	-	-	-	7	10	1	-	-	-	-	24	-	-	2.9	33
Linnaea borealis	-	-	1	1	3	7	-	5	-	2	-	-	4	1	2	1.7	60
Menziesia ferruginea	7	6	5	31	12	18	22	10	26	20	10	11	10	4	4	13.1	100
Oplopanax horridum	-	-	-	-	-	-	-	-	-	2	-	-	-	-	1	0.2	13
Ribes spp.	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	0.1	7
Rubus pedatus	6	-	2	7	8	-	2	6	2	10	3	1	-	1	1	3.3	80
Other Rubus spp.	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	7
Salix spp.	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	0.4	7
Sorbus spp.	-	-	-	-	-	1	-	1	2	-	-	-	-	-	-	0.3	20
Vaccinium vitis-idaea	-	-	-	-	-	4	2	2	6	-	2	-	10	-	-	1.7	40
Other Vaccinium spp.	15	-	8	-	16	3	-	3	6	22	5	7	8	-	-	6.2	67
Viburnum edule	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	0.5	7
Total	36	6	23	79	56	42	38	33	43	66	30	23	58	8	103	6.7	
Forbs:																	
Dryopteris dilatata	1	-	2	-	5	-	-	-	-	5	1	-	-	-	1	1.0	40
Epilobium spp.	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	0.3	7
Geolcaulon lividum	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	0.3	7
Gymnocarpium dryopteris	1	1	5	4	9	-	-	-	5	5	1	-	-	-	-	2.1	53
Pyrola spp.	-	-	-	-	-	-	-	-	-	-	3	-	1	-	-	0.3	13
Sanguisorba spp.	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	0.1	7
Thelypteris spp.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	7
Total	6	1	10	27	21	7	2	5	6	21	9	4	3	2	3	8.5	

Table 15a—continued

Species	Plots															Average cover	Constancy
	1	32	55	62	63	71	72	74	75	78	113	118	123	141	143		
	Percent cover[a]															Percent[b]	
Grasses:																	
Calamagrostis spp.	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	0.1	7
Carex spp.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	7
Mosses and lichens:																	
Alectoria spp.	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	0.1	7
Aulacomnium spp.	-	11	-	14	-	-	1	-	-	17	2	1	-	2	-	3.2	47
Cetraria spp.	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	0.1	13
Cladina spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	0.1	7
Cladonia spp.	1	1	-	3	1	1	-	-	-	1	1	1	-	1	-	0.7	60
Dicranum spp.	-	1	1	-	3	3	1	1	27	1	6	2	-	3	2	3.4	80
Hepaticae	-	-	-	1	-	-	-	-	10	-	-	-	-	-	1	0.8	20
Hylocomium spp.	26	29	15	13	15	1	43	42	3	25	21	34	9	38	12	21.7	100
Hypogmnia spp.	-	1	-	-	-	-	1	-	1	-	1	-	-	1	-	0.3	33
Other lichen species	-	-	-	2	-	-	-	-	-	1	1	-	-	-	-	0.3	20
Lobaria spp.	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	0.1	7
Lycopodium spp.	2	1	3	4	4	1	-	-	1	-	4	-	-	1	-	1.4	60
Mnium spp.	2	-	-	-	1	-	-	-	3	2	1	5	-	-	-	0.9	40
Other moss species	1	1	1	-	-	-	2	-	-	-	2	-	-	-	1	0.5	40
Nephroma spp.	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	0.1	13
Parmelia spp.	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	0.1	7
Peltigera spp.	-	2	1	2	1	3	4	3	2	-	1	-	-	2	1	1.5	73
Pleurozium schreberi	37	12	38	20	4	-	12	-	32	12	14	1	-	23	8	14.2	80
Polytrichum spp.	3	-	2	3	-	2	-	1	2	-	-	2	4	-	4	1.5	60
Ptilium spp.	-	-	6	7	1	-	-	3	1	-	8	5	1	-	2	2.3	60
Rhytidiadelphus spp.	11	4	2	-	36	51	-	8	-	3	-	10	29	-	5	10.6	67
Sphagnum spp.	9	4	18	1	11	22	5	26	-	17	20	18	46	12	-	13.9	87
Usnea	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	0.1	7
Total	92	67	87	70	77	84	70	85	83	79	84	79	90	86	36	77.9	

[a] Tr indicates that the cover of a species within a plot was < 1 percent cover. A dash indicates that the species was absent.

[b] Tr indicates that the average cover of a species was < 0.1 of 1 percent.

Table 15b—Site characteristics of Kenai vegetation plots belonging to the Closed *Picea* × *lutzii-Tsuga mertensiana/Menziesia ferruginea/Cornus canadensis/Sphagnum* spp. TWINSPAN subset *1000

Plot	Elevation	Principal cover[a]	Closure[b]	Stand age	Slope position	Slope	Aspect
	Meters			Years		Percent	
1	213.4	Conifer	Closed	138	Mid	66.0	NW
32	213.4	Mixed	Closed	63	Mid	68.4	NE
55	182.9	Conifer	Closed	108	Mid	18.2	NW
62	274.3	Conifer	Closed	47	Mid	33.0	NE
63	213.4	Conifer	Closed	150	Mid	8.2	SW
71	274.3	Conifer	Closed	95	Mid	43.0	NW
72	213.4	Conifer	Closed	97	Mid	34.4	SE
74	335.3	Conifer	Closed	155	Mid	19.8	SE
75	457.2	Conifer	Open	105	Mid	20.6	NW
78	304.8	Conifer	Closed	225	Mid	29.6	NE
113	121.9	Conifer	Closed	113	Mid	38.8	NW
118	213.4	Conifer	Closed	238	Mid	45.0	NW
123	213.4	Conifer	Closed	188	Mid	14.4	NW
141	243.8	Conifer	Closed	124	Mid	5.2	NW
143	61.0	Hardwood	Closed	49	Mid	11.2	SW

[a] A stand was classified as conifer if coniferous overstory trees contributed at least 75 percent of tree cover, and similarly for hardwoods. A stand was classified as mixed if neither overstory conifers nor hardwoods contributed at least 75 percent of tree cover.

[b] A stand was classified as closed, open, or woodland if overstory tree cover was at least 60, 25, or 10 percent, respectively. Stands with < 10 percent cover were considered to be nonforest land.

[c] Stand age was calculated as the average of as many as 6 coniferous site trees. Site trees were individuals that had maintained a dominant or codominant canopy position for most of their lives. When possible, site trees were selected from those trees included in the variable-radius plots. If an insufficient number of site trees was obtained from the variable-radius plots, then additional neighboring trees meeting the site tree criterion were selected if possible.

[d] Possible values for slope (topographic) position were flat, low(er slope), mid(slope), upper (slope), and rolling (terrain).

[e] Possible values for aspect are the cardinal compass directions (N, S, E, and W) or combinations (for example, NW, SE).

Table 15c—Soil characteristics of Kenai vegetation plots belonging to the Closed *Picea* × *lutzii-Tsuga mertensiana/Menziesia ferruginea/Cornus canadensis/Sphagnum* spp. TWINSPAN subset *1000

Plot	Depth of:[a]						Top mineral horizon		
	Impervious layer[b]	Saturated soil[b]	Root depth	Moss layer	Fibrous organic	Decomposed organic	Texture[c]	Coarse fragments[d]	Depth[a]
	Centimeters								Cm
1	51	-	26	10	31	42	SiL-L	VL	47
32	-	-	30	2	8	15	SiL-L	VL-H	40
55	-	-	21	2	6	9	SiL	VL-L	25
62	-	-	16	2	6	19	SiL-SL	M-H	28
63	73	68	22	6	13	20	SiL	VL	34
71	-	-	21	3	13	17	CL-SiL	VL	29
72	-	-	26	5	14	19	SiL	VL	30
74	87	-	20	5	10	20	SiL-SL	VL	34
75	-	-	23	2	5	13	SL	VL-L	42
78	-	-	26	3	9	15	SiL	VL	40
113	84	-	26	4	19	25	SiL	VL	40
118	40	82	22	2	7	10	SiL	VL	30
123	86	-	32	9	15	20	SiL	VL	37
141	-	-	19	4	12	17	SiL-SL	VL	49
143	-	-	14	1	4	8	SL	VL	20

[a] All depths were relative to the top of the moss layer on the soil surface.

[b] A dash indicates that a specific type of soil feature was not observed within the first 50 centimeters below the soil surface.

[c] Soil texture was determined for each of the 5 subplots. Texture classes were CL = clay loam, SiL = silt loam, L = loam, SL = sandy loam, and LS= loamy sand (or sand). For each plot, if the same texture class was recorded on at least 4 of the subplots, then that texture class is reported for the plot, otherwise a range of texture classes is indicated.

[d] The mineral fraction > 2 mm diameter was classed as coarse fragments. Coarse fragment content was recorded as very low (VL < 15 percent), low (15 percent < L < 30 percent), moderate (30 percent < M < 60 percent), or high (H > 60 percent).

Table 16a—Species composition of Kenai vegetation plots included in the Closed *Picea* × *lutzii*-*Tsuga mertensiana/Menziesia ferruginea-Oplopanax horridum/Dryopteris dilatata/Rhytidiadelphus* spp.-*Sphagnum* spp. community, TWINSPAN subset *1001

Species	Plots												Average cover	Constancy
	46	47	61	76	77	112	114	116	124	128	131	144		
	Percent cover[a]												Percent[b]	
Overstory:														
Betula papyrifera	-	-	-	-	-	-	22	-	2	-	15	15	4.5	33
Picea sitchensis	-	5	-	Tr	9	-	-	-	-	-	-	-	1.2	25
Picea X lutzii	35	38	6	63	66	44	46	67	100	55	55	98	56.1	100
Tsuga mertensiana	71	77	92	63	27	78	69	12	-	27	41	10	47.2	92
Total	106	120	98	126	102	122	137	79	102	82	111	123	109.0	
Reproduction:														
Betula papyrifera	-	-	-	-	-	-	-	-	1	-	-	-	0.1	8
Picea sitchensis	-	1	-	-	-	-	-	-	-	-	-	-	0.1	8
Tsuga mertensiana	2	10	4	-	1	-	-	4	-	1	-	-	1.8	50
Total	2	11	4	0	1	0	0	4	1	1	0	0	2.0	
Shrubs:														
Alnus spp.	14	7	-	16	4	-	27	-	4	17	-	-	7.4	58
Cornus canadensis	-	2	-	2	1	1	8	-	9	4	-	-	2.2	58
Linnaea borealis	-	-	-	-	1	-	-	-	-	-	-	-	0.1	8
Menziesia ferruginea	9	6	19	10	10	20	9	6	6	25	21	9	12.5	100
Oplopanax horridum	2	2	2	6	5	-	7	-	11	4	31	3	6.1	83
Ribes spp.	1	-	-	-	-	-	3	-	1	1	-	-	0.5	33
Rubus pedatus	5	16	6	11	7	7	15	17	6	5	2	-	8.1	92
Other Rubus spp.	-	1	-	-	-	-	-	-	-	-	-	-	0.1	8
Salix spp.	-	-	-	-	-	-	-	-	-	-	1	-	0.1	8
Sambucus racemosa	-	-	-	-	1	-	-	-	-	-	1	-	0.2	17
Sorbus spp.	-	-	-	-	-	-	-	-	-	-	2	-	0.2	8
Vaccinium spp.	1	8	28	4	3	1	4	3	1	-	-	-	4.4	75
Viburnum edule	-	-	-	-	-	-	-	-	-	-	-	1	0.1	8
Total	32	42	55	49	32	29	73	26	38	56	58	13	41.9	
Forbs:														
Actaea rubra	-	2	-	-	-	-	-	-	-	-	-	-	0.2	17
Aruncus sylvester	-	-	-	-	-	-	-	-	-	1	-	-	0.1	8
Athyrium filix-femina	-	-	-	2	4	-	-	-	-	-	-	-	0.5	17
Dryopteris dilatata	10	7	9	5	2	-	12	12	7	-	7	3	6.2	83
Epilobium spp.	-	-	-	-	-	-	-	-	1	-	1	-	0.2	17
Equisetum spp.	-	-	-	-	-	-	2	-	-	-	-	-	0.2	8
Gymnocarpium dryopteris	1	1	3	6	7	-	8	-	5	2	4	-	3.1	75
Polystichum braunii	-	-	-	-	-	-	-	-	-	2	-	-	0.2	8
Pyrola spp.	-	-	-	-	1	-	-	-	5	-	-	-	0.5	17
Sanguisorba spp.	-	-	2	-	-	-	-	-	-	-	-	-	0.2	8
Smilacina spp.	-	-	1	-	-	-	-	-	-	-	-	-	0.1	8
Streptopus spp.	1	-	-	-	1	-	-	-	5	-	-	-	0.6	25

Table 16a—continued

Species	Plots												Average cover	Constancy
	46	47	61	76	77	112	114	116	124	128	131	144		
	Percent cover[a]												Percent[b]	
Thelypteris spp.	-	-	-	1	-	-	-	-	-	1	-	-	0.2	17
Tiarella spp.	-	-	-	4	-	-	-	-	-	-	-	-	0.3	8
Trientalis europaea	1	-	-	-	-	-	-	-	-	-	1	-	0.2	17
Viola spp.	-	-	1	-	-	-	-	-	-	-	-	-	0.1	8
Total	13	10	16	18	15	-	22	12	23	6	13	3	12.6	
Grasses:														
Calamagrostis spp.	-	-	4	-	-	-	-	-	3	-	1	-	0.7	25
Mosses and lichens:														
Alectoria spp.	1	-	-	-	-	-	-	8	-	-	1	-	0.8	25
Aulacomnium spp.	2	-	-	6	-	-	-	6	-	1	-	-	1.2	33
Cladonia spp.	-	-	-	-	-	-	-	-	-	1	-	2	0.2	17
Dicranum spp.	6	1	12	2	1	3	1	1	1	-	-	-	2.3	75
Hepaticae	-	1	-	-	-	-	-	-	-	-	-	-	0.1	8
Hylocomium spp.	3	22	-	25	22	61	17	18	38	24	6	-	19.7	83
Hypogmnia spp.	1	-	-	-	-	-	-	-	1	-	-	-	0.2	17
Other lichen species	-	-	-	1	-	-	-	-	-	1	1	-	0.2	25
Lobaria spp.	-	-	-	-	-	-	-	-	-	1	-	-	0.1	8
Lycopodium spp.	2	-	-	-	1	-	4	3	5	4	-	-	1.6	50
Mnium spp.	-	6	6	1	8	2	2	-	5	2	7	-	3.2	75
Other moss species	2	4	55	8	-	7	-	5	1	1	1	12	8.0	83
Peltigera spp.	-	-	-	-	-	-	1	-	-	2	-	-	0.2	17
Pleurozium schreberi	4	12	-	3	-	7	-	-	-	4	5	-	2.9	50
Polytrichum spp.	2	3	-	-	1	-	-	6	1	1	2	3	1.6	67
Ptilium spp.	9	5	-	-	3	3	3	-	14	2	5	-	3.7	67
Rhytidiadelphus spp.	3	7	-	-	3	1	8	2	7	5	5	5	3.8	83
Sphagnum spp.	-	12	11	-	13	3	20	3	10	5	-	-	6.4	67
Total	35	73	84	46	52	87	53	52	81	54	33	22	56.0	

[a] Tr indicates that the cover of a species within a plot was < 1 percent cover. A dash indicates that the species was absent.

[b] Tr indicates that the average cover of a species was < 0.1 of 1 percent.

Table 16b—Site characteristics of Kenai vegetation plots belonging to the Closed *Picea* × *lutzii-Tsuga mertensiana/Menziesia ferruginea-Oplopanax horridum/Dryopteris dilatata/Rhytidiadelphus* spp.-*Sphagnum* spp. community, TWINSPAN subset *1001

Plot	Elevation	Principal cover[a]	Closure[b]	Stand age	Slope position	Slope	Aspect
	Meters			Years		Percent	
46	426.7	Conifer	Closed	102	Mid	33.4	SW
47	182.9	Conifer	Closed	227	Mid	44.0	SE
61	213.4	Conifer	Closed	185	Mid	28.6	SE
76	304.8	Conifer	Closed	158	Mid	32.2	SW
77	213.4	Conifer	Closed	114	Mid	22.6	SW
112	152.4	Conifer	Closed	230	Mid	54.6	SE
114	243.8	Conifer	Closed	184	Mid	12.6	NW
116	304.8	Conifer	Closed	127	Mid	86.8	NW
124	152.4	Conifer	Closed	128	Low	3.2	NW
128	274.3	Conifer	Closed	128	Mid	60.2	SE
131	304.8	Conifer	Open	55	Mid	44.2	NE
144	91.4	Conifer	Closed	131	Mid	60.0	SE

[a] A stand was classified as conifer if coniferous overstory trees contributed at least 75 percent of tree cover, and similarly for hardwoods. A stand was classified as mixed if neither overstory conifers nor hardwoods contributed at least 75 percent of tree cover.

[b] A stand was classified as closed, open, or woodland if overstory tree cover was at least 60, 25, or 10 percent, respectively. Stands with < 10 percent cover were considered to be nonforest land.

[c] Stand age was calculated as the average of as many as 6 coniferous site trees. Site trees were individuals that had maintained a dominant or codominant canopy position for most of their lives. When possible, site trees were selected from those trees included in the variable-radius plots. If an insufficient number of site trees was obtained from the variable-radius plots, then additional neighboring trees meeting the site tree criterion were selected if possible.

[d] Possible values for slope (topographic) position were flat, low(er slope), mid(slope), upper (slope), and rolling (terrain).

[e] Possible values for aspect are the cardinal compass directions (N, S, E, and W) or combinations (for example, NW, SE).

Table 16c—Soil characteristics of Kenai vegetation plots belonging to the Closed *Picea* × *lutzii-Tsuga mertensiana/Menziesia ferruginea-Oplopanax horridum/ Dryopteris dilatata/Rhytidiadelphus* spp.-*Sphagnum* spp. community, TWINSPAN subset *1001

Plot	Depth of:[a]						Top mineral horizon		
	Impervious layer[b]	Saturated soil[b]	Root depth	Moss layer	Fibrous organic	Decomposed organic	Texture[c]	Coarse fragments[d]	Depth[a]
	Centimeters								Cm
46	-	-	24	3	9	16	SiL-SL	VL-H	39
47	-	-	23	5	8	10	SiL	VL-M	22
61	-	84	18	2	6	11	SiL-L	VL	23
76	85	-	26	4	9	12	SiL-L	VL	29
77	-	-	25	10	18	23	SiL	VL-M	39
112	-	-	20	4	8	13	SiL	VL	31
114	-	75	23	2	9	22	SiL-LS	VL-M	36
116	23	-	18	1	7	18	CL	VL	23
124	-	-	14	7	11	14	LS	L-H	28
128	-	-	18	4	15	26	SiL-L	VL	44
131	43	-	21	2	13	16	SL	VL	20
144	87	-	32	3	11	19	SiL	VL-H	40

[a] All depths were relative to the top of the moss layer on the soil surface.

[b] A dash indicates that a specific type of soil feature was not observed within the first 50 centimeters below the soil surface.

[c] Soil texture was determined for each of the 5 subplots. Texture classes were CL = clay loam, SiL = silt loam, L = loam, SL = sandy loam, and LS = loamy sand (or sand). For each plot, if the same texture class was recorded on at least 4 of the subplots, then that texture class is reported for the plot, otherwise a range of texture classes is indicated.

[d] The mineral fraction > 2 mm diameter was classed as coarse fragments. Coarse fragment content was recorded as very low (VL < 15 percent), low (15 percent < L < 30 percent), moderate (30 percent < M < 60 percent), or high (H > 60 percent).

Table 17a—Species composition of Kenai vegetation plots included in the Closed *Picea sitchensis/Oplopanax horridum-Rubus pedatus/Dryopteris dilatata-Gymnocarpium dryopteris/Mnium* spp.-*Rhytidiadelphus* spp. community, TWINSPAN subset *101

Species	Plots								Average cover	Constancy
	2	3	4	93	107	110	111	125		
	Percent cover[a]								Percent[b]	
Overstory:										
Picea glauca	-	-	-	-	-	Tr	-	-	Tr	12
Picea sitchensis	100	100	Tr	-	18	100	100	-	52.3	75
Picea X lutzii	-	-	100	100	8	-	-	95	25.4	50
Tsuga mertensiana	-	-	-	-	70	-	-	15	10.6	25
Total	100	100	100	100	96	100	100	110	100.7	
Reproduction:										
Picea sitchensis	-	3	-	-	-	-	2	-	0.6	25
Picea X lutzii	-	-	-	-	4	-	-	1	0.6	25
Tsuga mertensiana	-	-	-	-	9	-	-	-	1.1	12
Total	0	3	0	0	13	0	2	1	2.4	
Shrubs:										
Alnus spp.	-	-	-	3	-	-	4	3	1.2	37
Cornus canadensis	-	-	-	-	3	3	2	3	1.4	50
Cornus suecica	-	-	-	-	-	1	-	-	0.1	12
Linnaea borealis	1	-	-	-	-	-	-	-	0.1	12
Menziesia ferruginea	1	2	-	1	3	11	-	-	2.2	62
Oplopanax horridum	16	36	28	5	3	16	3	29	17.0	100
Rubus pedatus	12	42	10	18	7	20	24	15	18.5	100
Other Rubus species	-	2	-	-	5	-	1	-	0.7	37
Sambucus racemosa	-	-	1	-	-	-	-	-	0.1	12
Vaccinium spp.	2	7	7	-	17	20	64	1	14.7	87
Viburnum edule	-	-	1	-	-	-	-	-	0.1	12
Total	32	89	47	27	38	71	98	51	56.6	
Forbs:										
Athyrium filix-femina	20	-	-	-	-	-	1	-	2.6	25
Caltha spp.	-	-	-	-	1	-	-	-	0.1	12
Dryopteris dilatata	4	13	31	-	22	40	-	12	15.2	75
Equisetum spp.	-	-	-	-	-	1	-	-	0.1	12
Gymnocarpium dryopteris	31	30	21	2	-	17	9	16	15.7	87
Listera cordata	1	2	-	-	4	-	-	-	0.9	37
Moneses uniflora	1	3	-	5	-	-	-	-	1.1	37
Pyrola spp.	-	-	-	-	1	-	-	-	0.1	12
Streptopus spp.	-	-	2	-	2	1	-	2	0.9	50
Thelypteris spp.	-	-	-	49	-	-	-	-	6.1	12
Tiarella spp.	7	16	6	-	11	-	1	1	5.2	75
Total	64	64	60	56	41	59	11	31	48.2	
Grasses:										
Calamagrostis spp.	-	-	2	-	3	-	-	-	0.6	25
Mosses and lichens:										
Aulacomnium spp.	-	2	-	-	-	-	-	4	0.7	25
Cladina spp.	-	1	-	-	-	-	-	1	0.2	25
Cladonia spp.	-	-	-	-	-	-	-	1	0.1	12
Dicranum spp.	11	2	-	4	6	2	-	3	3.5	75
Hepaticae	-	-	1	-	-	-	-	1	0.2	25
Hylocomium spp.	13	19	13	10	17	26	15	2	14.4	100
Hypogmnia spp.	-	1	-	-	-	-	-	1	0.2	25
Other lichen species	-	-	-	1	-	1	1	1	0.5	50
Lobaria spp.	-	-	-	2	-	-	-	1	0.4	25

See footnotes at and of table.

Table 17a—continued

Species	Plots 2	3	4	93	107	110	111	125	Average cover	Constancy
	Percent cover[a]								Percent[b]	
Mosses and lichens:										
Lycopodium spp.	1	8	5	-	-	8	1	1	3.0	75
Mnium spp.	45	10	22	25	5	9	-	20	17.0	87
Other moss species	6	3	1	17	2	9	5	1	5.5	100
Pleurozium schreberi	3	-	7	5	-	1	-	19	4.4	62
Polytrichum spp.	-	-	4	-	1	2	-	-	0.9	37
Ptilium spp.	-	-	-	-	-	4	-	-	0.5	12
Rhytidiadelphus spp.	15	57	35	4	40	-	68	22	30.0	87
Sphagnum spp.	-	-	-	-	5	12	-	-	2.1	25
Usnea spp.	-	-	-	-	-	-	1	-	0.1	12
Total	94	103	88	68	76	74	91	78	84.0	

[a] Tr indicates that the cover of a species within a plot was < 1 percent cover. A dash indicates that the species was absent.

[b] Tr indicates that the average cover of a species was < 0.1 of 1 percent.

Table 17b—Site characteristics of Kenai vegetation plots belonging to the Closed *Picea sitchensis/Oplopanax horridum-Rubus pedatus/Dryopteris dilatata-Gymnocarpium dryopteris/Mnium* spp.-*Rhytidiadelphus* spp. community, TWINSPAN subset *101

Plot	Elevation	Principal cover[a]	Closure[b]	Stand age	Slope position	Slope	Aspect
	Meters			Years		Percent	
2	213.4	Conifer	Closed	137	Mid	40.0	NW
3	30.5	Conifer	Open	137	Mid	18.2	SW
4	30.5	Conifer	Closed	89	Mid	4.8	SW
93	243.8	Conifer	Closed	130	Mid	42.2	NW
107	91.4	Conifer	Open	215	Mid	48.0	NE
110	61.0	Conifer	Closed	143	Mid	41.2	SW
111	30.5	Conifer	Closed	139	Flat	2.4	None
125	182.9	Conifer	Closed	153	Low	3.2	NW

[a] A stand was classified as conifer if coniferous overstory trees contributed at least 75 percent of tree cover, and similarly for hardwoods. A stand was classified as mixed if neither overstory conifers nor hardwoods contributed at least 75 percent of tree cover.

[b] A stand was classified as closed, open, or woodland if overstory tree cover was at least 60, 25, or 10 percent, respectively. Stands with < 10 percent cover were considered to be nonforest land.

[c] Stand age was calculated as the average of as many as 6 coniferous site trees. Site trees were individuals that had maintained a dominant or codominant canopy position for most of their lives. When possible, site trees were selected from those trees included in the variable-radius plots. If an insufficient number of site trees was obtained from the variable-radius plots, then additional neighboring trees meeting the site tree criterion were selected if possible.

[d] Possible values for slope (topographic) position were flat, low(er slope), mid(slope), upper (slope), and rolling (terrain).

[e] Possible values for aspect are the cardinal compass directions (N, S, E, and W) or combinations (for example, NW, SE).

Table 17c—Soil characteristics of Kenai vegetation plots belonging to the Closed *Picea sitchensis/Oplopanax horridum-Rubus pedatus/Dryopteris dilatata-Gymnocarpium dryopteris/Mnium* spp.-*Rhytidiadelphus* spp. community, TWINSPAN subset *101

Plot	Depth of:[a]						Top mineral horizon		
	Impervious layer[b]	Saturated soil[b]	Root depth	Moss layer	Fibrous organic	Decomposed organic	Texture[c]	Coarse fragments[d]	Depth[a]
	Centimeters								Cm
2	-	-	18	1	2	4	SiL	VL	29
3	-	83	21	2	6	11	SiL	VL	20
4	-	-	26	6	9	11	SiL	VL	22
93	71	-	16	2	6	11	SiL	VL	32
107	84	-	22	2	5	10	L	VL-M	37
110	-	-	17	2	11	19	L-LS	VL	38
111	-	-	11	2	6	8	SiL-LS	VL	15
125	-	-	14	2	5	8	SL-LS	VL-M	20

[a] All depths were relative to the top of the moss layer on the soil surface.

[b] A dash indicates that a specific type of soil feature was not observed within the first 50 centimeters below the soil surface.

[c] Soil texture was determined for each of the 5 subplots. Texture classes were CL = clay loam, SiL = silt loam, L = loam, SL = sandy loam, and LS = loamy sand (or sand). For each plot, if the same texture class was recorded on at least 4 of the subplots, then that texture class is reported for the plot, otherwise a range of texture classes is indicated.

[d] The mineral fraction > 2 mm diameter was classed as coarse fragments. Coarse fragment content was recorded as very low (VL < 15 percent), low (15 percent < L < 30 percent), moderate (30 percent < M < 60 percent), or high (H > 60 percent).

Table 18a—Species composition of Kenai vegetation plots included in the Open *Picea* × *lutzii-Populus trichocarpa/Alnus* spp.-*Oplopanax horridum/Dryopteris dilatata* community, TWINSPAN subset *11

SPECIES	Plots 23	31	54	73	99	Average cover	Constancy
	- - - Percent cover[a] - -					- - Percent[b] - - -	
Overstory:							
Betula papyrifera	-	-	-	-	6	1.2	20
Picea glauca	-	55	-	Tr	-	11.1	40
Picea sitchensis	-	-	16	-	-	3.2	20
Picea X lutzii	33	-	-	34	99	33.2	60
Populus trichocarpa	6	5	82	-	-	18.6	60
Tsuga mertensiana	-	-	-	34	-	6.8	20
Total	39	60	98	68	105	74.0	
Shrubs:							
Alnus spp.	10	59	61	6	10	29.2	100
Linnaea borealis	-	-	-	-	4	0.8	20
Menziesia ferruginea	-	-	-	1	-	0.2	20
Oplopanax horridum	10	12	46	18	11	19.4	100
Ribes spp.	-	3	-	5	-	1.6	40
Rubus pedatus	-	-	-	9	13	4.4	40
Sambucus racemosa	1	2	1	5	3	2.4	100
Total	21	76	108	44	41	58.0	
Forbs:							
Athyrium filix-femina	-	-	5	-	1	1.2	40
Dryopteris dilatata	-	22	5	38	37	20.4	80
Epilobium spp.	-	-	-	-	3	0.6	20
Equisetum spp.	-	-	-	-	16	3.2	20
Galium spp.	-	1	1	-	-	0.4	40
Gymnocarpium dryopteris	-	18	10	-	18	9.2	60
Sanguisorba spp.	-	-	-	-	2	0.4	20
Streptopus spp.	-	-	-	1	-	0.2	20
Trientalis europaea	-	1	-	5	-	1.2	40
Total	0	42	21	44	77	36.8	
Grasses:							
Calamagrostis spp.	-	-	-	-	14	2.8	20
Mosses and lichens:							
Aulacomnium spp.	-	-	-	10	1	2.2	40
Dicranum spp.	-	-	-	-	1	0.2	20
Hylocomium spp.	-	-	1	-	-	0.2	20
Hypnum spp.	-	-	-	-	4	0.8	20
Hypogmnia spp.	-	-	-	-	2	0.4	20
Other lichen species	-	-	1	-	1	0.4	40
Lycopodium spp.	-	-	-	2	5	1.4	40
Mnium spp.	-	-	2	-	32	6.8	40
Other moss species	-	-	3	6	15	4.8	60
Pleurozium schreberi	-	-	-	-	1	0.2	20
Rhytidiadelphus spp.	-	-	2	-	-	0.4	20
Total	0	0	9	18	62	17.8	

[a] Tr indicates that the cover of a species within a plot was < 1 percent cover. A dash indicates that the species was absent.

[b] Tr indicates that the average cover of a species was < 1-tenth of one percent.

Table 18b—Site characteristics of Kenai vegetation plots belonging to the Open *Picea* × *lutzii-Populus trichocarpa/Alnus* spp.-*Oplopanax horridum/Dryopteris dilatata* community, TWINSPAN subset *11

Plot	Elevation	Principal cover[a]	Closure[b]	Stand age	Slope position	Slope	Aspect
	Meters			Years		Percent	
23	30.5	Conifer	Woods	69	Mid	15.4	SW
31	304.8	Conifer	Open	178	Mid	4.6	SW
54	61.0	Hardwood	Open	146	Flat	1.0	None
73	396.2	Conifer	Closed	116	Mid	43.4	SW
99	152.4	Conifer	Closed	140	Flat	5.8	None

[a] A stand was classified as conifer if coniferous overstory trees contributed at least 75 percent of tree cover, and similarly for hardwoods. A stand was classified as mixed if neither overstory conifers nor hardwoods contributed at least 75 percent of tree cover.

[b] A stand was classified as closed, open, or woodland if overstory tree cover was at least 60, 25, or 10 percent, respectively. Stands with < 10 percent cover were considered to be nonforest land.

[c] Stand age was calculated as the average of as many as 6 coniferous site trees. Site trees were individuals that had maintained a dominant or codominant canopy position for most of their lives. When possible, site trees were selected from those trees included in the variable-radius plots. If an insufficient number of site trees was obtained from the variable-radius plots, then additional neighboring trees meeting the site tree criterion were selected if possible.

[d] Possible values for slope (topographic) position were flat, low(er slope), mid(slope), upper (slope), and rolling (terrain).

[e] Possible values for aspect are the cardinal compass directions (N, S, E, and W) or combinations (for example, NW, SE).

Table 18c—Soil characteristics of Kenai vegetation plots belonging to the Open *Picea* × *lutzii-Populus trichocarpa/Alnus* spp.-*Oplopanax horridum/Dryopteris dilatata* community, TWINSPAN subset *11

Plot	Depth of:[a]						Top mineral horizon		
	Impervious layer[b]	Saturated soil[b]	Root depth	Moss layer	Fibrous organic	Decomposed organic	Texture[c]	Coarse fragments[d]	Depth[a]
	Centimeters								Cm
23	-	83	54	0	10	18	LS	L-M	47
31	-	80	16	2	8	11	SL-LS	VL-H	30
54	-	-	17	0	4	7	CL-SiL	VL	14
73	59	-	17	2	7	14	CL-L	VL-M	36
99	-	-	14	3	8	12	SiL	VL	28

[a] All depths were relative to the top of the moss layer on the soil surface.

[b] A dash indicates that a specific type of soil feature was not observed within the first 50 centimeters below the soil surface.

[c] Soil texture was determined for each of the 5 subplots. Texture classes were CL = clay loam, SiL = silt loam, L = loam, SL = sandy loam, and LS = loamy sand (or sand). For each plot, if the same texture class was recorded on at least 4 of the subplots, then that texture class is reported for the plot, otherwise a range of texture classes is indicated.

[d] The mineral fraction > 2 mm diameter was classed as coarse fragments. Coarse fragment content was recorded as very low (VL < 15 percent), low (15 percent < L < 30 percent), moderate (30 percent < M < 60 percent), or high (H > 60 percent).

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A total of 5,597 photo points was systematically located on 1:60,000-scale high-altitude photographs of the Kenai Peninsula, Alaska; photo interpretation was used to classify the vegetation at each grid position. Of the total grid points, 12.3 percent were classified as timberland; 129 photo points within the timberland class were randomly selected for field survey. The number of sample points visited in each of three forest cover types (conifer, broadleaf, and mixed conifer-broadleaf) was proportional to the frequency of the cover type in the photo sample. Two-way indicator species analysis (TWINSPAN) was used to develop a hierarchical classification of the forest communities observed on the peninsula. Brief descriptions are presented for the 11 recognized communities with a discussion of their relation to basic physiographic and edaphic characteristics.

Keywords: Vegetation classification, Kenai Peninsula, Alaska.

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